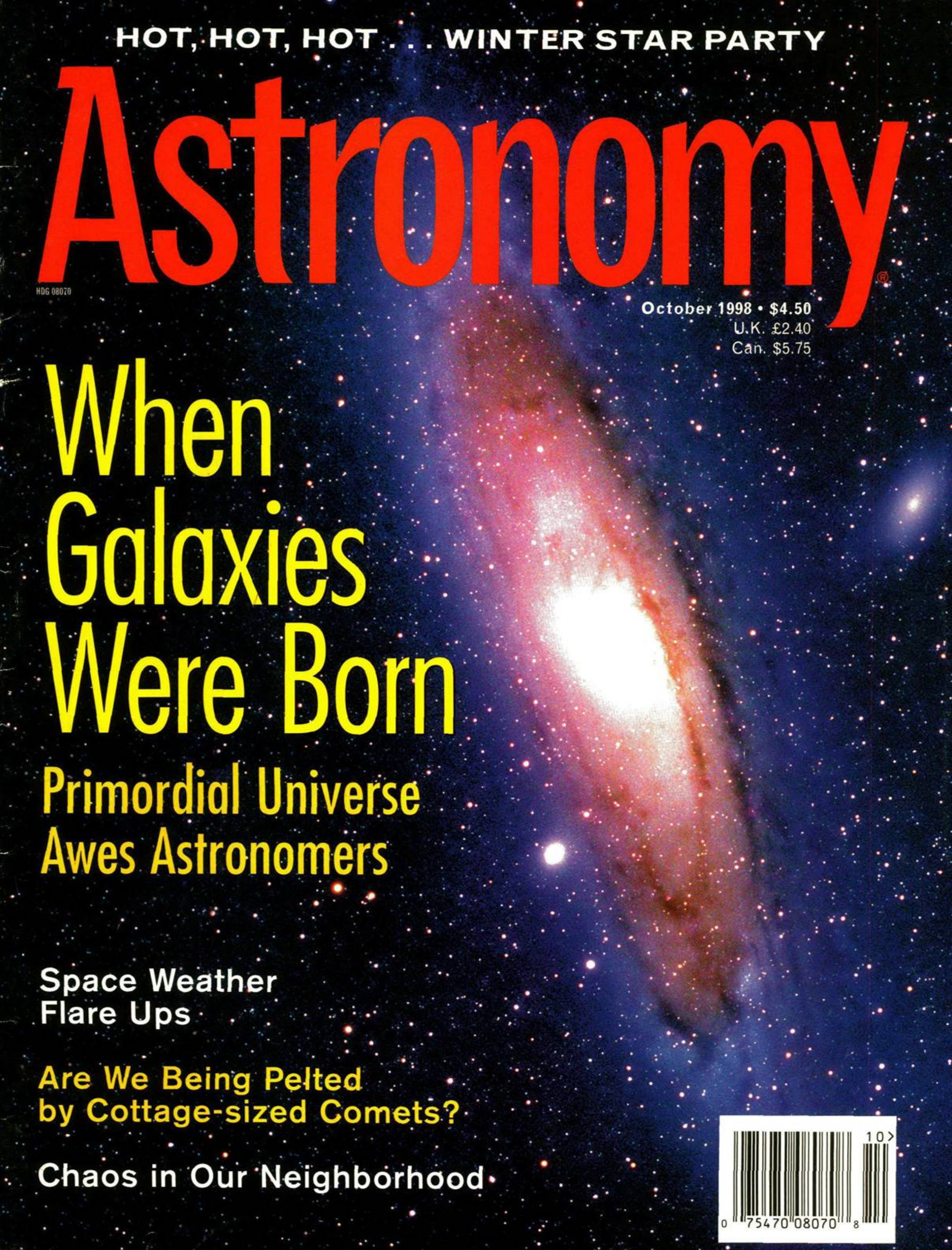


HOT, HOT, HOT . . . WINTER STAR PARTY

Astronomy

HDG 08070

October 1998 • $4.50
U.K. £2.40
Can. $5.75

When Galaxies Were Born

Primordial Universe Awes Astronomers

Space Weather Flare Ups

Are We Being Pelted by Cottage-sized Comets?

Chaos in Our Neighborhood

10>
0 75470 08070 8

MEADE LX50

Advanced technology at the most affordable prices *ever.*

- **Battery-Powered, Completely Cordless Operation!** Meade LX50 models operate for more than 50 hours from six AA-size batteries inserted through the telescope's control panel. Or use the standard-equipment 25 ft. cord to power the telescope directly from any auto cigarette lighter plug.

- **Standard-Equipment Declination Motor and Hand Controller:** Plug the hand controller into the LX50 control panel and you're ready for full dual-axis drive capability at any of 4 photo-guide or microslew speeds: 2x, 8x, 16x, or 32x, plus quartz-controlled sidereal-rate tracking in R.A. Switch speeds instantly using the speed-control button on the hand controller. Dual-axis drive rate is indicated by a red LED.

- **Multi-Function Control Panel:** Includes connectors for CCD autoguiders; for the standard-equipment Declination motor; and for the optional Magellan II Computer-Corrector *(below).* A North-South switch permits telescope operation anywhere in the world.

- **Super Multi-Coated Optics:** The exact same EMC super multi-coated optical tube assemblies included with Meade LX200 models.

- **Massive LX200-type Fork Mounts:** Meade LX50 mounts are manufactured of the same virgin aluminum castings as Meade LX200 Schmidt-Cassegrains. Massive, rigid mountings that include the Meade LX worm-gear drive system with low periodic error for advanced photographic or CCD imaging applications. *No competing mid-priced equatorial mountings even come close.*

SPECIFICATIONS: 7", 8", and 10" LX50's—Each complete telescope includes 8" or 10" f/10 Schmidt-Cassegrain or 7" f/15 Maksutov-Cassegrain optical tube assembly with EMC super multi-coatings; heavy-duty LX200-type fork mount; 5.75" LX worm gear system in R.A.; multi-function control panel; DC servo Declination motor; manual and electric slow-motion controls on both axes; setting circles on both axes; keypad hand controller; 4-speed drive controls on both axes; battery compartment accepting six (user-supplied) AA-size batteries; 25 ft. power cord for telescope operation from 12v. auto cigarette lighter plug; 6 x 30mm (7" and 8" models) or 8 x 50mm (10") viewfinder; 1.25" diagonal prism; MA25mm multi-coated eyepiece (1.25"); standard equatorial wedge with elevation scale, bubble level, and azimuth control; complete operating instructions.

Meade Magellan™ II Computer-Corrector for LX50 Telescopes: Plug the Magellan II into the control panel of your LX50 and enjoy an incredible range of advanced capabilities. ■ Fast manual slewing to any object, either from input RA and Dec or from the 12,218-object database. ■ High-resolution 4096-pulse encoders (5.3 arc-minute precision), concealed in special LX50 encoder compartments. ■ Large 32-character, red-backlighted display. ■ Quick 2-star alignment. ■ Four-speed (2x, 8x, 16x, 32x sidereal) dual-axis drive corrector/microslewing system.

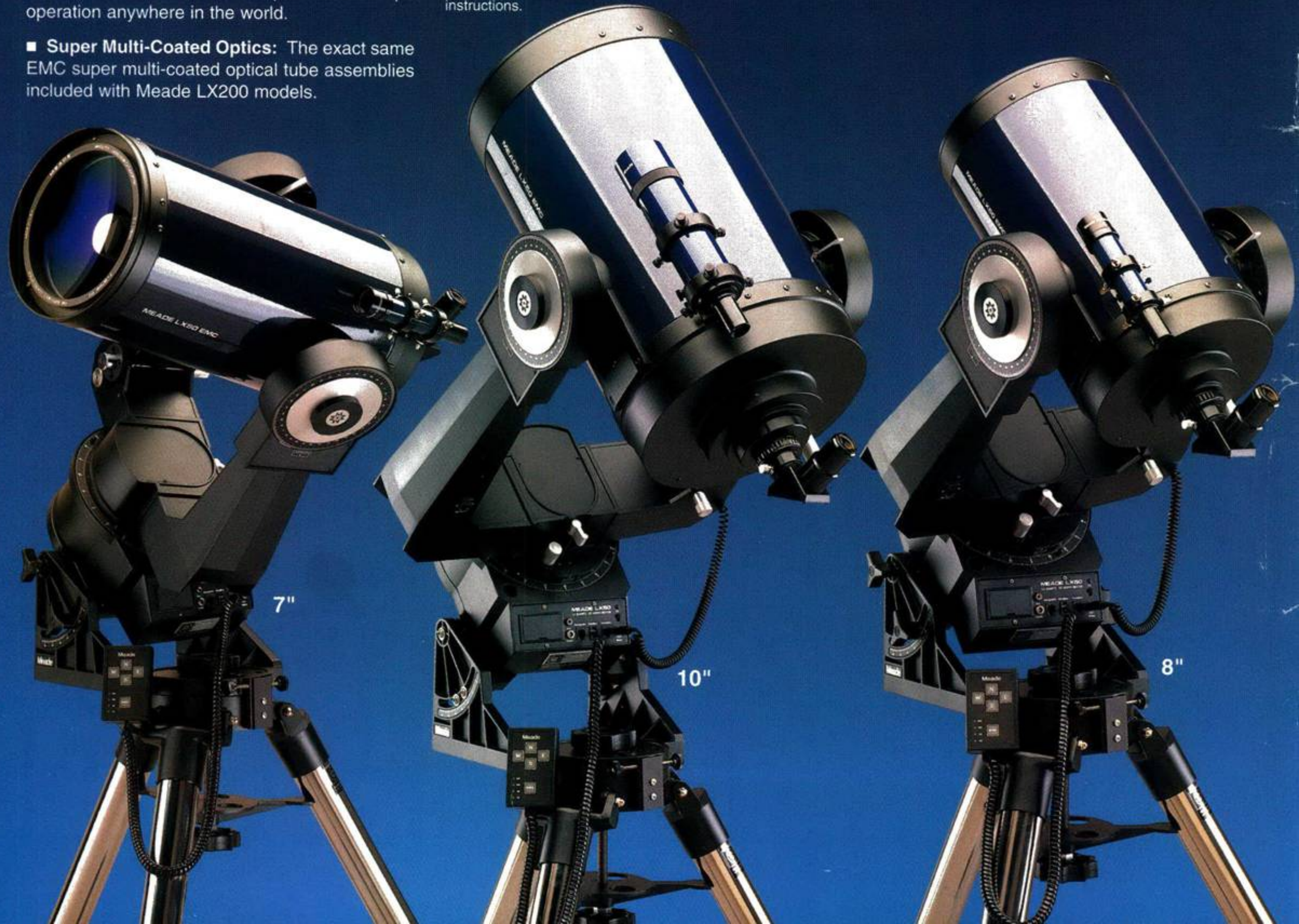
MEADE
MAGELLAN II
ENTER
MODE
FIND
N
W
E
S
7
8
9
4
5
6
1
2
3
0

only $495!

#2024: Magellan II for LX50's—Includes Magellan II hand controller *(right)*; encoders for both axes; all required mounting hardware. Installs to any LX50 in minutes. **$495.** + $15 packing and shipping in the 48 states.

8" LX50 Schmidt-Cassegrain	**$1395.**
10" LX50 Schmidt-Cassegrain	**1695.**
7" LX50 Maksutov-Cassegrain	**1795.**
Variable-Height Field Tripod	**295.**
7" Maksutov-Cassegrain Tube Ass'y	**1295.**

Packing and shipping in the 48 states: 8"—$105; 10"—$145; 7"—$125; 7" Tube Assembly—$65.



MEADE LX200

The largest-selling serious telescopes in the world.

In virtually every country in the world where serious telescopes are sold, more Meade LX200's are sold than all competing models *combined*. Consider these *standard-equipment* specifications:

- **Superb Optics:** LX200 diffraction-limited imaging capabilities are a legend in the industry; we regularly receive reports stating that optical performance approaches that of a fine *ED* apochromatic lens.
- **Automatic GO TO Capability:** Meade LX200's are *the only commercial telescopes ever manufactured* that automatically GO TO any input R.A. and Dec., or to any of 64,359 objects in the onboard database, *to a precision of one arc-minute or better.*
- **Meade LX200 High-Precision Pointing™** is so precise it permits the positioning of *every* selected object on *every* commercially-available CCD chip *every* time, automatically — *a feat that no other telescope priced under $40,000 can accomplish.*
- **Permanently-Programmable Smart Drive™** routinely achieves 5 arc. sec. periodic error, an observatory standard.
- **9-Speed Dual-Axis Electronics:** Electronics that cover every possible contingency of telescope positioning—from 2x photo-guide, to 32x image centering, to 8°/sec. slewing across the sky, as well as 6 other dual-axis drive speeds in between.
- **Field Operation:** No other telescopes of such incredible capabilities transport so readily for field operation. The optional #1812 Electronic DC Adapter (a compact 4 oz. unit) allows for field powering directly from an automobile cigarette lighter plug.

SPECIFICATIONS: 7", 8", 10", and 12" LX200's—Each complete telescope includes 8" or 10" (f/6.3 or f/10) or 12" f/10 Schmidt-Cassegrain or 7" f/15 Maksutov-Cassegrain optical tube assembly with EMC super multi-coatings; heavy-duty fork mount with 4" polar ball bearing, dual-axis 5.75" worm gears, and multi-function control panel; manual and electric slow-motion controls on both axes; keypad hand controller with digital readout display, permanently programmable Smart Drive, 9-speed drive controls on both axes (7-speed on 12"), High-Precision Pointing, and GO TO controller; 64,359-object onboard celestial software library; 25 ft. power cord and adapter for telescope operation from 115v.AC; 8 x 50mm viewfinder; 1.25" diagonal prism (7", 8", 10") or 2" diagonal mirror with 1.25" adapter (12"); Series 4000 Super Plössl 26mm eyepiece; standard field tripod (7", 8", 10") or giant field tripod (12"); operating instructions.

8" LX200 Schmidt-Cassegrain	**$2795.**
10" LX200 Schmidt-Cassegrain	**3195.**
12" LX200 Schmidt-Cassegrain	**4495.**
7" LX200 Maksutov-Cassegrain	**3295.**

Packing and shipping in the 48 states: 8"—$105; 10"—$145; 12"—$215; 7"—$125.

MEADE LX200 EMC
8"
7"
10"
12"
Meade

Write, call, or fax Meade Instruments for your free copy of the 100-page Meade General Catalog.

Prices shown are suggested U.S. mail-order retail prices.

ADVANCED PRODUCTS DIVISION
Meade Instruments Corporation
World's Leading Manufacturer of Astronomical Telescopes for the Serious Amateur
6001 Oak Canyon, Irvine, California 92620 ☐ (949) 451-1450
FAX: (949) 451-1460 ☐ *www.meade.com*

© 1998

October 1998 • Vol. 26, No. 10

Astronomy®

COVER PHOTO: Jerry Lodriguss

FEATURES

42 Great Discoveries

The history of astronomy is chock full of defining moments. Here are 25 that have changed the way we see the universe.

44 Seeing Spots

Louis Frank believes that 25,000 house-sized comets smash into Earth's atmosphere every day, but many astronomers think this is folly. *Kathy Sawyer.*

50 Solar System Redeux

Far from the stately arena we once thought, our home system bristles with rogue comets and other dangers. *John P. Wiley, Jr.*

COVER

54 Outsmarting the Early Universe

Pioneering a technique to find distant galaxies, Chuck Steidel hopes to learn how the cosmos evolved. *Marcia Bartusiak.*

60 Blowin' in the Solar Wind

Massive solar storms can wreak havoc on satellites in orbit, humans in space, and on Earth itself. *Adam Frank.*

82 Celestial Portraits: Aquarius

For the galaxy lover in all of us, Aquarius and Piscis Austrinus offer great hunting for the backyard observer. *Tom Polakis.*

88 Sunny Skies and Starry Nights

Escape winter's cold and head to the Florida Keys, where warm breezes and great observing await. *Andrea Gianopoulos.*

94 Dome Sweet Dome

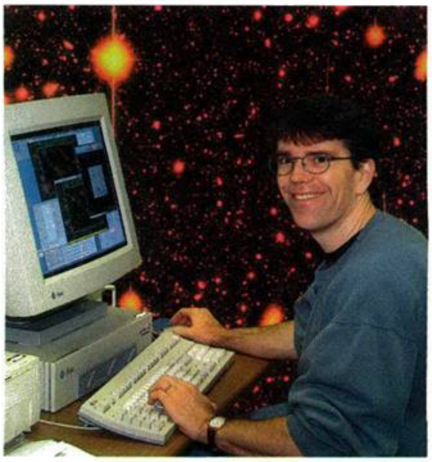
The frozen lava of the moon's maria is just the tip of the lunar volcanism iceberg. *Jim Bell.*

96 Ask Astro

We answer your questions about the sky and the universe.

50 Chaos in the Solar System

94 Dome Sweet Dome NOAA



54 When Galaxies Were Born

Barbara Schaefer (W.M. Keck Observatory)

DEPARTMENTS

44 Pelted by Tiny Comets
Brian Ray

6 Behind the Scenes
- Hearty Party

14 Talking Back

22 AstroNews
- Two New Planets Revealed
- SOHO, Phone Home
- Martian Dust Devils Imaged
- Blasting Asteroids
- Plasma Loops on the Sun
- White Ovals Come Together
- First Light for Deep-Sky Survey
- A New Class of Star
- Rosetta Stone

68 Sky Show
- Bright planets dominate the night, but you shouldn't miss a pair of meteor showers or the return of Comet Giacobini-Zinner. *Martin Ratcliffe and Alister Ling.*

100 Star Stuff

Products
- SKY/mount
- Overhead Skies: A Teaching Planisphere
- X-Y Micro-Slides
- Paramount GT-1100 Robotic Telescope Mount

Books
- The Little Book of the Big Bang: A Cosmic Primer
- Moon Missions: Mankind's First Voyage to Another World

Bytes
- Mercury CD-ROM
- TryOrbit

116 Looking Ahead

120 Advertiser Index

121 Hot Shots
- On the Go in South America

126 Ultimate Exposure

88 Winter Star Party Jeff Weber

42 25 Great Discoveries
NASA/JPL

60 Weather in Space National Solar Observatory/Sacramento Peak

BEHIND THE SCENES

BY BONNIE BILYEU GORDON

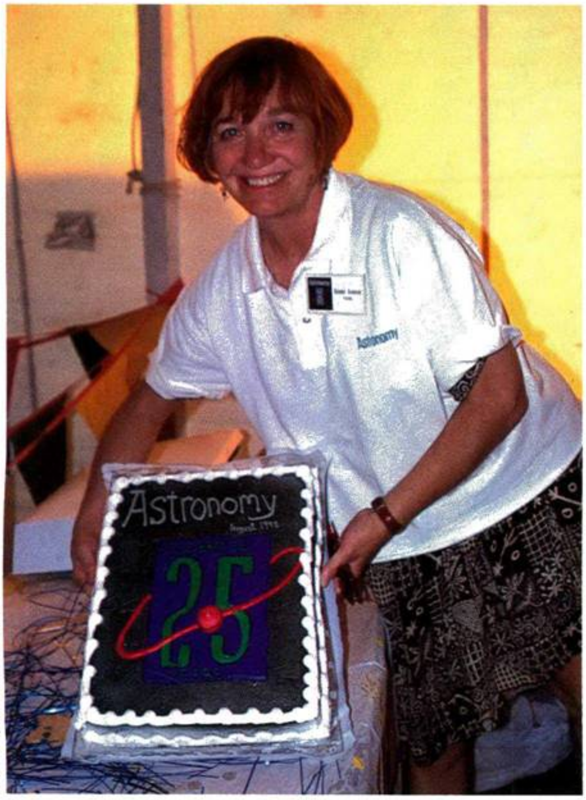
Hearty Party

"We should have a star party of our own," said photo editor Patti Kurtz while brainstorming with her *Astronomy* colleagues for the magazine's 25th-anniversary celebrations. Everyone looked at her in surprise. Some groaned. I said "Okay, Patti, we can do that. You're in charge," thinking this would end the discussion.

Patti wound up putting together a star party in Rio Rancho, New Mexico, that brought several thousand people to celebrate and watch the skies with us. (The official count was 2,470 parked cars.) It didn't start out looking nearly that successful. When we arrived a day early to look at the site — Rio Rancho Balloon Park — one recreational vehicle was parked on a huge dirt field. Richard, the RV driver from Florida, wanted to know where everybody was. (He was later rewarded for his punctuality. He won the fine ETX telescope that Meade Instruments kindly donated for the gathering).

By 7 a.m. on Star Party Day, June 25, the dirt field held an 80-by-80-foot tent, and vendors, space artists, volunteers from The Albuquerque Astronomical Society (TAAS), Rio Rancho recreation specialists, and *Astronomy* staffers were filling the tent. We began staking out vendor stalls and hanging party decorations. We felt like members of a prom committee. By noon when we were finished, most of the vendors had arrived from faraway places such as Massachusetts and New York. The big tent was swarming, and the wind was beginning to blow. Hot wind.

Editor Bonnie Gordon shows off an anniversary cake.



Astronomy: Andrea Gianopoulos

By noon, it must have been 90 degrees inside the tent. But outside, the big winds were really blowing the dust around. Vendors were losing their cover and begging to be pulled inside. We all squeezed in together. At about 1:30 p.m., our guests began to arrive. Kids filed out of school buses, and high school astronomy club members and boy scouts ambled in.

To delight them all, the Albuquerque Rocket Society planned rocket launches, but it was too windy. Children's activity centers were being put together outside, but it was too windy. The University of New Mexico Lodestar learning center lured the kids into the

(See Scenes, p. 14)

Astronomy®

EDITORIAL STAFF

EDITOR
Bonnie Bilyeu Gordon
MANAGING EDITOR
David J. Eicher
SENIOR EDITOR
Rex Graham
ASSOCIATE EDITORS
Andrea Gianopoulos, Robert Naeye, Tracy Staedter, Richard Talcott
PHOTO EDITOR
Patricia Kurtz
COPY EDITORS
Jeanette Brown, Sarah Simpson
EDITORIAL ASSISTANT
Terry Williams Conley
EDITORIAL SECRETARY
Julie Sherwin
CONTRIBUTING EDITORS
Ray Jayawardhana, Beth Livermore, John Shibley, Tom Yulsman

ART STAFF

ART DIRECTOR
Carole Kramer
ASSISTANT ART DIRECTOR
Thomas Ford
GRAPHIC DESIGNER
Katherine Kolstedt
ILLUSTRATORS
Elisabeth Rowan and Terri Field
PRODUCTION COORDINATOR
Helene Tsigistras

EDITORIAL ADVISORY BOARD

Buzz Aldrin, Marcia Bartusiak, Timothy Ferris, Paul Hodge, John S. Gallagher III, Anne L. Kinney, Edward Kolb, Alan Lightman, Stephen P. Maran, Boyce Rensberger, James Trefil

PUBLISHER

Russell G. Larson

Astronomy HOME PAGE The Audit Bureau
http://www.astronomy.com

ASTRONOMY (ISSN 0091-6358, USPS 531-350) is published monthly by Kalmbach Publishing Co., 21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187. Editorial phone: (414) 796-8776; advertising: (800) 558-1544; customer service: (800) 446-5489; subscriptions: (800) 533-6644, Monday through Friday, 8:30 a.m. — 5 p.m. CT; fax (414) 796-0126. Copyright © 1998 Kalmbach Publishing Co., all rights reserved. Material in this publication may not be reproduced without permission. Periodicals postage paid at Waukesha, WI, and additional offices. Printed in the U.S.A. Allow 6 to 8 weeks for new subscriptions and address changes. Subscription price: 1 year $39.95, Canadian and foreign: 1 year $50, payable in U.S. funds (Canadian price includes GST). BN 12271 3209 RT. Canadian International Publications Mail Products Agreement 545-775. Not responsible for unsolicited material. POSTMASTER send address changes to ASTRONOMY, 21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187-1612.

MEADE ETX™

ETX Astro Telescope mounted on optional Field Tripod.

Diffraction-limited imaging and ultraportability ...at only $595, complete!

The revolutionary Meade ETX goes anywhere with you at a moment's notice and presents the finest optical images ever made available in an ultraportable telescope.

SPECIFICATIONS: ETX Astro Telescope — Includes Maksutov-Cassegrain optical tube assembly (D = 90mm, F = 1250mm, f/13.8) with EMC super multi-coatings; internal flip-mirror system for either straight-through or 90° observing position; equatorial fork mount with slow-motion controls, locks, and setting circles in R.A. and Dec; table tripod with elevation scale on center tripod leg; motor drive system with internal battery compartment accepting three (user-supplied) AA-size batteries; 8 x 21mm achromatic erect-image viewfinder; Series 4000 Super Plössl 26mm eyepiece (1.25"); operating instructions. Net weight 9 lbs.

$595 (+ $20 packing & shipping in the 48 states)

ETX Field Tripod — The rigid, full-length ETX Field Tripod allows for seated or standing observations through the telescope; tripod height is adjustable from 34" to 54". Micrometric controls in both azimuth and elevation-angle permit precise polar alignment of the telescope's fork mount for astronomical applications. For terrestrial observing, where altazimuth orientation is desirable, the tripod head tilts to 90°. The telescope attaches to the tripod in seconds with two thumbscrews. Net weight 11 lbs.

$169 (+ $10 packing & shipping in the 48 states)

Tilt and lock the ETX Field Tripod to 90° for terrestrial observing.

ADVANCED PRODUCTS DIVISION

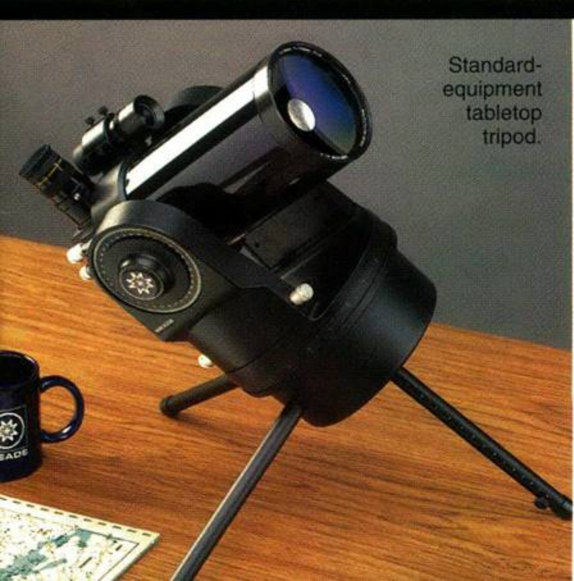
Meade Instruments Corporation

World's Leading Manufacturer of Astronomical Telescopes for the Serious Amateur

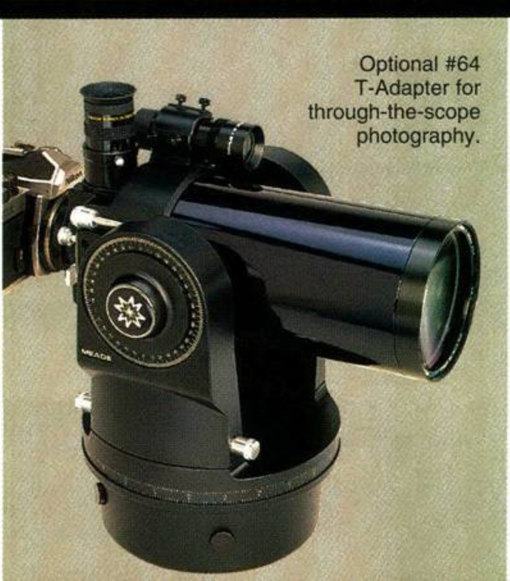
6001 Oak Canyon, Irvine, California 92620 ▫ (949) 451-1450
FAX: (949) 451-1460 ▫ *www.meade.com*

© 1998

Prices shown are suggested U.S. mail-order retail prices.



Standard-equipment tabletop tripod.



Optional #64 T-Adapter for through-the-scope photography.

AUTHORIZED U.S. NATIONAL MAIL-ORDER DEALERS

ASTRONOMICS, Norman, OK.
Orders: 800-422-7876; Info.: 405-364-0858.

FOCUS CAMERA, Brooklyn, NY.
Orders: 800-221-0828; Info.: 718-436-6262.

LUMICON, Livermore, CA.
Orders: 800-767-9576; Info.: 510-447-9570.

OCEANSIDE PHOTO & TELESCOPE, Oceanside, CA.
Orders & Information: 800-483-6287.

POCONO MOUNTAIN OPTICS, Moscow, PA.
Orders: 800-569-4323; Info.: 717-842-1500.

RIVERS CAMERA, Dover, NH.
Orders: 800-245-7963; Info.: 603-742-4888.

SHUTAN CAMERA & VIDEO, Chicago, IL.
Orders & Info.: 800-621-2248; IL: 312-332-2000.

Canada:

EFSTONSCIENCE, Toronto, Ontario.
Orders & Information: 416-787-4581.

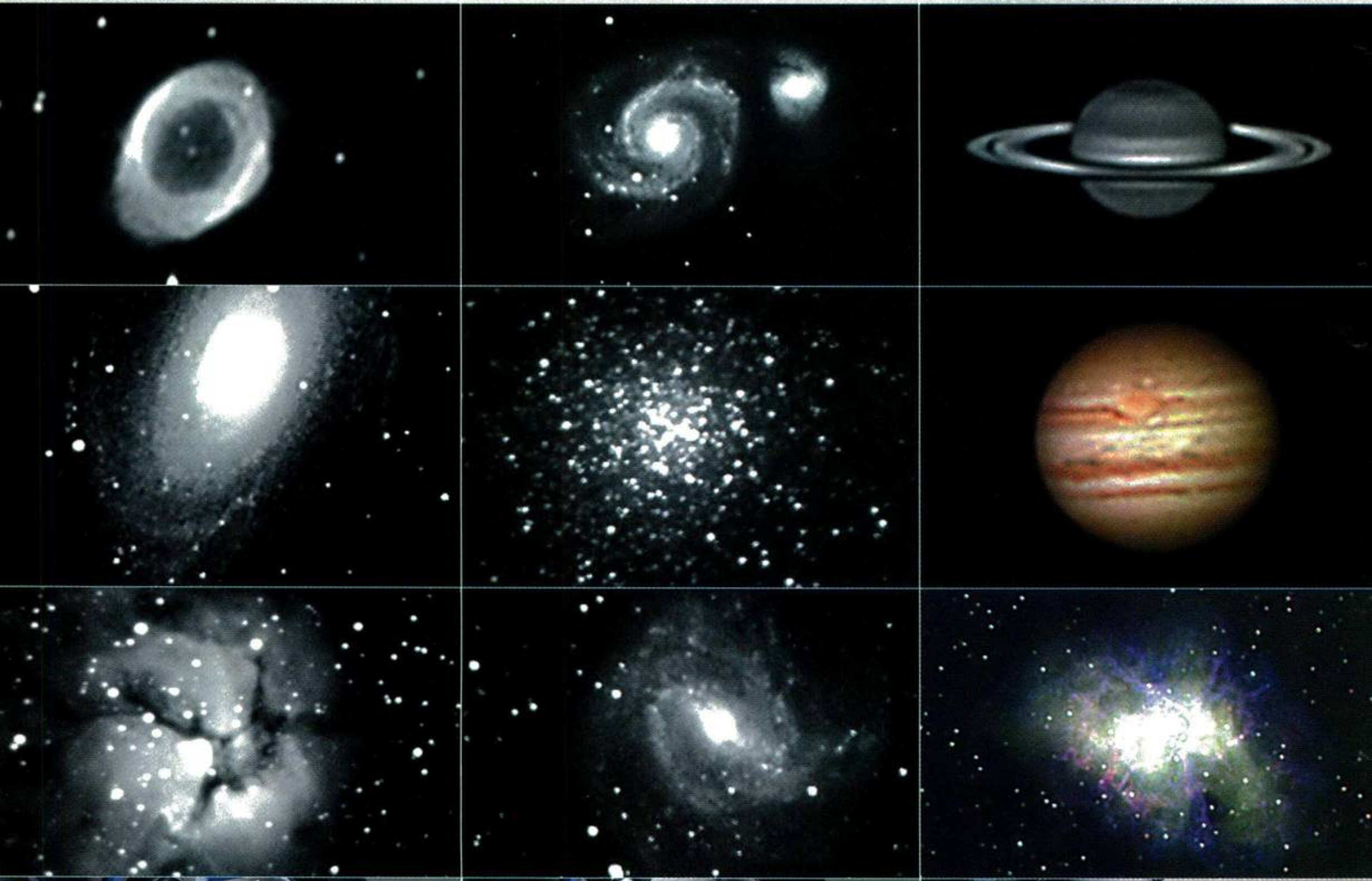
KHAN SCOPE CENTRE, Toronto, Ontario.
Orders & Information: 416-783-4140.

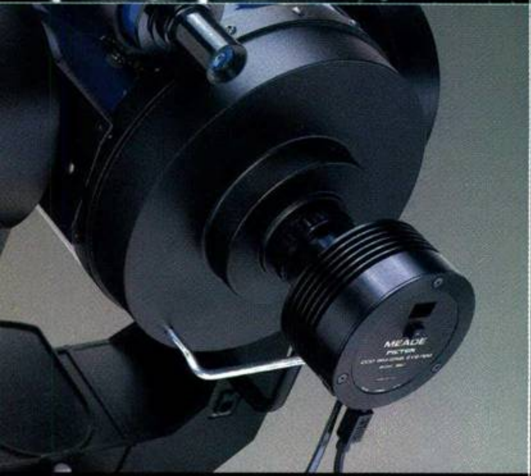
MEADE® PICTOR™ AUTOGUIDER/IMAGERS

Pictor 208XT images *(top to bottom):* Ring Nebula (M57), 25" reflector, Jack Newton; Galaxy (M81) in Ursa Major, 12" LX200, Scott Roberts; Trifid Nebula (M20), 8" LX200, John Hoot.

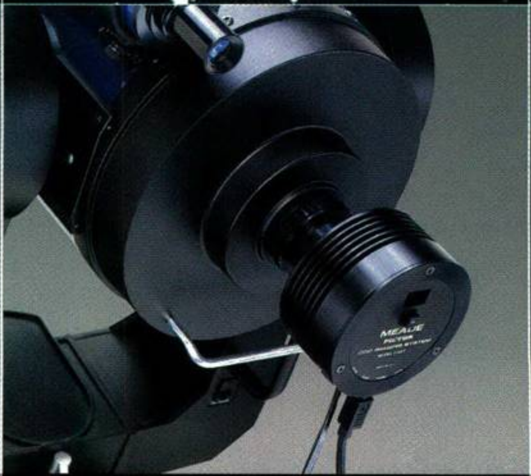
Pictor 216XT images: Whirlpool Galaxy (M51), 12" LX200, John Hoot; Globular Cluster (M13), 25" reflector, Jack Newton; Galaxy (M83) in Hydra, 12" LX200, Scott Roberts.

Pictor 416XT images: Saturn (in green light), 16" LX200, Dr. Donald Parker; Jupiter, 10" LX200 with Stellar Products AO-2 seeing adapter, Dr. Donald Bruns; Crab Nebula (M1), 25" reflector, Jack Newton.





Pictor 208XT: $495 ***complete***



Pictor 216XT: $695 ***complete***

Shipped **FREE** with Pictor 201XT Autoguider, CCD Off-Axis Guider, Image Orienter, and Epoch 2000ip Image Processing Software, as shown!

Pictor 416XT: $1695 ***complete***
includes $800 Meade CCD Equipment System

Revolutionary Meade Pictor CCD's are now the world's largest-selling autoguiders and imagers for the amateur astronomer. No other electronic imaging systems offer such an incredible range of capabilities at such amazing price levels. At only **$495** the **Pictor 208XT** produces on the PC display fine, high-resolution 8-bit images *in seconds* of the Moon and planets, or, in 2 or 3 minutes, of thousands of deep-space objects. At **$695** the **Pictor 216XT** enables advanced 16-bit imaging and is *by far* the finest autoguider/imager ever made available at under-$1000. At **$1695** the **Pictor 416XT** permits professional-level imaging capability for the amateur astronomer: an electronic camera capable of producing with amateur telescopes images of the Moon, planets, and deep-space that match or exceed the photographic images obtained with many observatory telescopes. All models are available for immediate shipment.

For complete information on Meade CCD imaging systems write, call, or fax for your free copy of the 100-page Meade General Catalog.

© 1998

Model 102ACHR/500:
4" f/9 Achromatic
Refractor — **$995.**

Model 114NT/500:
4.5" f/8 Newtonian
Reflector —
$595.

Model 127NT/500:
5" f/8 Newtonian
Reflector — **$695.**

Model 102APO/500:
4" f/9 *ED* Apochromatic
Refractor — **$1695.**

Model 203SC/500:
8" f/10 Schmidt-
Cassegrain
— **$1295.**

Shown with optional #1702 Dual-Axis Drive System

MEADE 500-Series

Experience all of the high-resolution optical performance and mechanical precision of a MEADE reflector, refractor, or Schmidt-Cassegrain, at a moderate pricing level. Each complete 500-Series model includes the all-new MEADE LXD 500 equatorial mount with dual-axis worm gears, engraved setting circles, micrometric slow-motion controls in RA and Dec, rigid aluminum tripod, and a full complement of accessories. Choose from among five models the one that's right for your budget and observing requirements. *For complete details send for your free copy of the Meade 1998-99 General Catalog.* Optional systems for Meade 500-Series telescopes include:

#1701 Single-Axis RA Drive System	**$145.**
#1702 Dual-Axis Drive System, with 4-speed hand controller	**195.**
#812 Polar Alignment Finder	**49.**

Prices shown are suggested U.S. national mail-order retail prices.

Packing and shipping: 4" models—$55; 4.5" and 5"—$45; 8"—$65.

ADVANCED PRODUCTS DIVISION
Meade Instruments Corporation
World's Leading Manufacturer of Astronomical Telescopes for the Serious Amateur
6001 Oak Canyon, Irvine, California 92620 ■ (949) 451-1450
FAX: (949) 451-1460 ■ *www.meade.com*

© 1998

MEADE STARFINDER DOBSONIANS

No other competing Dobsonians include this listing of *standard-equipment* features:

Primary and Secondary Mirrors of Low-Expansion Pyrex® Glass: Unlike the plate glass optics of other Dobsonians that can become thermally unstable, all Meade Dobsonian optics are made of Grade-A fine-annealed Pyrex glass — the exact same professional-quality optics used on Meade Starfinder Equatorials.

Rigid, Durable, Beautiful Dobsonian Mountings, manufactured of cabinet-quality materials, provide extremely smooth motions of the telescope in both altitude and azimuth. Both telescope axes ride on zero-backlash Teflon/Nylon bearings, facilitating the quick location and easy tracking of celestial objects.

Full-Size 1.25" Rack-and-Pinion Focuser: For smooth, precise focusing of the image without wobble or backlash. Focus travel is 2.6"; accepts 1.25" eyepieces.

4-Vane Steel Secondary Mirror System: Permits locked-in support and precise centration and alignment of the secondary mirror.

Multi-Coated MA25mm Eyepiece (1.25"): The Meade Modified Achromatic 25mm eyepiece yields sharp, high-resolution imaging to the field edge.

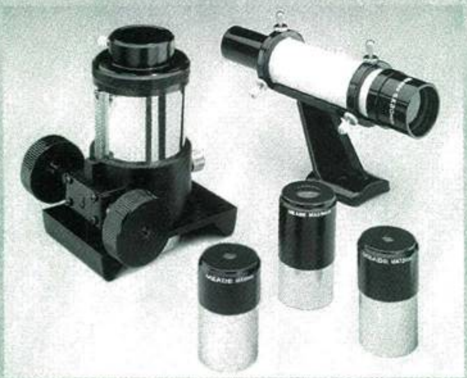
5 x 24mm Viewfinder: Included with all Starfinder Dobsonian models for quick object-location in the main telescope. With crosshair eyepiece and 2-ring bracket.

Optical Tubes: Starfinder Dobsonians include the same strong, spiral-wound Sonotube™ optical tubes used on Starfinder Equatorials *(right)*, tubes with excellent insulating characteristics that reduce internal thermal currents to an absolute minimum.

Performance! *Meade Starfinder Dobsonians and Equatorials are the largest-selling Newtonian reflectors of their apertures in the world.* Every Starfinder model opens up the skies to an extremely wide range of serious visual observing; all 110 Messier objects, thousands of NGC objects — nebulae, galaxies, star clusters, in all their variations of form, color, and extent, as well as the Moon and planets in stunning high-resolution detail. Starfinder Dobsonians are telescopes for visual observing; motor-driven Starfinder Equatorials may be used, in addition, for lunar and planetary photography, and even for limited deep-space photography.

Packing & UPS Shipping Charges to any address in the 48 states: 6"—$39; 8"—$49; 10"—$69; 12.5"—$79; 16"—$45 packing, shipped truck freight collect.

Dobsonian Deluxe Accessory Package only $49.95!



Outfit your Meade Dobsonian with all of the most popular accessories for advanced observing. At the time you order any Dobsonian model, specify the following Deluxe Accessory Package for your telescope, in place of the standard-equipment focuser, viewfinder, and eyepiece, ***for a total of only $49.95 additional:***

1 - **Meade #77 2" Giant Rack-and-Pinion Focuser,** with machined aluminum eyepiece-holders for both 2" and 1.25" eyepieces; includes drawtube lock and 2.6" focuser travel. *(reg. $59.95)*

1 - **Meade #637 6 x 30mm Achromatic Viewfinder,** with wide 7° field; 2-ring metal bracket. *(reg. $49.95)*

3 - **Meade MA9mm, 12mm, and 25mm** multi-coated eyepieces, 1.25" barrel — eyepieces for the full range of lunar, planetary, and deep-space observing. *(reg. $37.95 each)*

Purchased separately, the Deluxe Accessory Package sells for $223.75!

Meade Magellan I Telescope Computer System

Attach the optional Magellan I Telescope Computer System to your Starfinder Dobsonian and finding any of 12,218 celestial objects, or *any* object of known R.A. and Dec., is almost as easy as pointing the telescope! Magellan I's database includes the following objects:

7,840	NGC objects; the complete NGC catalog
4,093	IC objects from the Index Catalog
125	user-defined objects
110	Messier objects; the complete catalog
42	alignment stars for the Magellan system
8	major planets, from Mercury to Pluto
12,218	objects, total

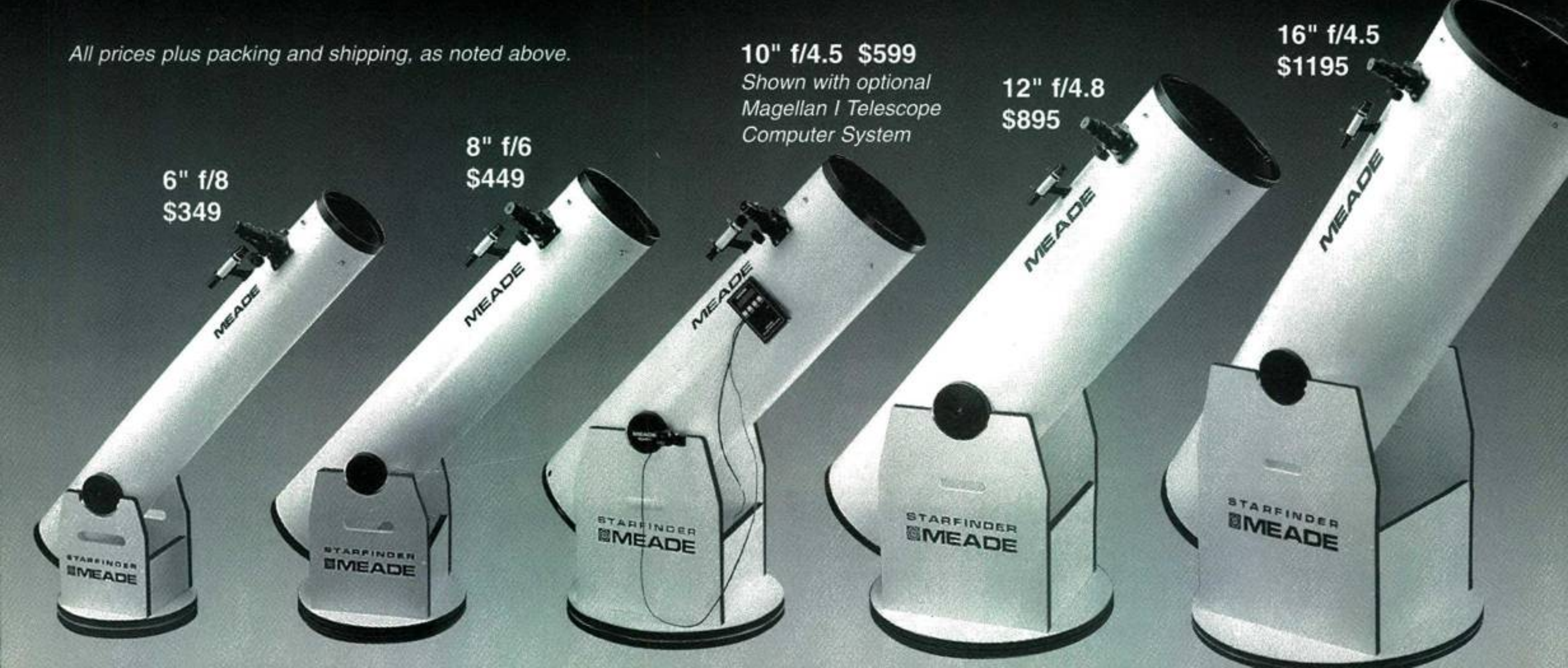
MEADE
ENTER
MODE
PREV
NEXT
ON
MAGELLAN I
TELESCOPE COMPUTER SYSTEM

Magellan I is supplied *complete* with control/display unit (4" x 5" x 1.25"); premium-grade, high-resolution encoders for each telescope axis (encoder precision is 5.3 arc minutes); RS-232 serial interface; bracket for placement of the controller on the telescope tube; and attachment hardware. Just add the user-supplied 9v. transistor radio battery, and Magellan I is ready to use. First-time installation is quick and simple.

#2010: for Meade Starfinder Dobsonian
6", 8", 10", 12.5", or 16" . . . . $295.
Packing & shipping in the 48 states—$15.

STARFINDER DOBSONIAN TELESCOPES ***Shown with standard-equipment 5 x 24mm viewfinder and 1.25" rack-and-pinion focuser.***

All prices plus packing and shipping, as noted above.



6" f/8
$349

8" f/6
$449

10" f/4.5 $599
Shown with optional Magellan I Telescope Computer System

12" f/4.8
$895

16" f/4.5
$1195

MEADE STARFINDER EQUATORIALS

Special Eyepiece Offer! At the time you order any Meade Starfinder Equatorial telescope, you can buy 2 additional multi-coated eyepieces, MA9mm and 12mm, ***for a total of $29.95!*** *Purchased separately, the 2 eyepieces sell for $75.90.*

The fullest exposition of Meade astronomical telescopes, CCD imagers, and telescope accessories is contained in the 100-page Meade General Catalog.

Write, call, or fax Meade Instruments for your free copy!

DC-powered drive systems for fully automatic tracking, and a wide range of standard-equipment features:

Professional-Grade Optical System: Includes hand-figured, parabolic primary mirror and elliptical flat secondary, both of Grade-A Pyrex glass. Optics are multi-coated and meet the theoretical limits of resolution.

Precision Equatorial Mount: Manufactured of machined aluminum to tolerances of .001" or better, with 4"-dia. pier and die-cast tripod legs for rock-solid support of the optical tube. Moves effortlessly from object to object on precision bearing surfaces. Polar and Dec. shafts are 1" solid steel. Setting circles on both axes.

Battery-Powered Cordless Drive System! Provides fully automatic tracking of celestial objects. Operates for more than 50 hours from 6 (user-supplied) AA-size batteries. Control panel also permits powering the telescope from 12v. auto cigarette lighter plug, using optional 25 ft. cord.

2" Giant Focuser: Meade #77 2" giant rack-and-pinion focuser is included as standard equipment, with eyepiece-holders for both 2" and 1.25" eyepieces.

Accessories and Components: #637 6 x 30mm viewfinder with wide 7° field; multi-coated MA25mm eyepiece (1.25"); strong, durable, spiral-wound optical tube with attractive white finish.

Starfinder Equatorial 16: Includes equatorial mounting with 1.5" steel shafts, Sealmaster ball bearings, 6" dia. pier, and 6 x AA-size battery-powered worm gear drive; 8 x 50mm viewfinder; #77 2" giant focuser.

Packing & UPS Shipping Charges to any address in the 48 states: 6"—$65; 8"—$75; 10"—$90; 16"—$55 packing, shipped truck freight collect.

Meade Magellan Telescope Computer Systems

MEADE
ENTER
MODE
PREV
NEXT
ON
MAGELLAN I
TELESCOPE COMPUTER SYSTEM

Magellan I: Use the Magellan I computer to manually slew the telescope quickly to any of 12,218 database objects, or to any object of known R.A. and Dec. Specifications and object database are identical to Magellan I for Starfinder Dobsonians *(see facing page)*.

#2011: for Meade (DC-powered) Starfinder Equatorial 6", 8", or 10" . . . . $295.
#2012: for Meade (DC-powered) Starfinder Equatorial 16" . . . . 295.

MEADE
MAGELLAN II
COMPUTER CORRECTOR
ENTER
MODE
FIND
N
W
E
S

Magellan II Computer-Corrector: Plug the Magellan II into the control panel of your Meade Starfinder Equatorial and you have all the capabilities of the Magellan I, above, including 12,218-object database, *plus* a 4-speed (2x, 8x, 16x, 32x), dual-axis, drive corrector/microslewing system.

#2018: for (DC-powered) Starfinder Equatorial 6", 8", 10" . . 495.
#2019: for (DC-powered) Starfinder Equatorial 16" . . . . 595.

Packing & shipping in the 48 states: Magellan I–$15, Magellan II–$20.

To Order: Contact your authorized Meade Advanced Products Mail-Order Dealer, below. Prices shown are suggested U.S.A. mail-order retail prices.

ASTRONOMICS, Norman, OK.
Orders: 800-422-7876; Info.: 405-364-0858.

FOCUS CAMERA, Brooklyn, NY.
Orders: 800-221-0828; Info.: 718-436-6262.

LUMICON, Livermore, CA.
Orders: 800-767-9576; Info.: 510-447-9570.

OCEANSIDE PHOTO & TELESCOPE, Oceanside, CA.
Orders & Information: 800-483-6287.

POCONO MOUNTAIN OPTICS, Moscow, PA.
Orders: 800-569-4323; Info.: 717-842-1500.

RIVERS CAMERA, Dover, NH.
Orders: 800-245-7963; Info.: 603-742-4888.

SHUTAN CAMERA & VIDEO, Chicago, IL.
Orders & Info.: 800-621-2248; IL: 312-332-2000.

Canada:

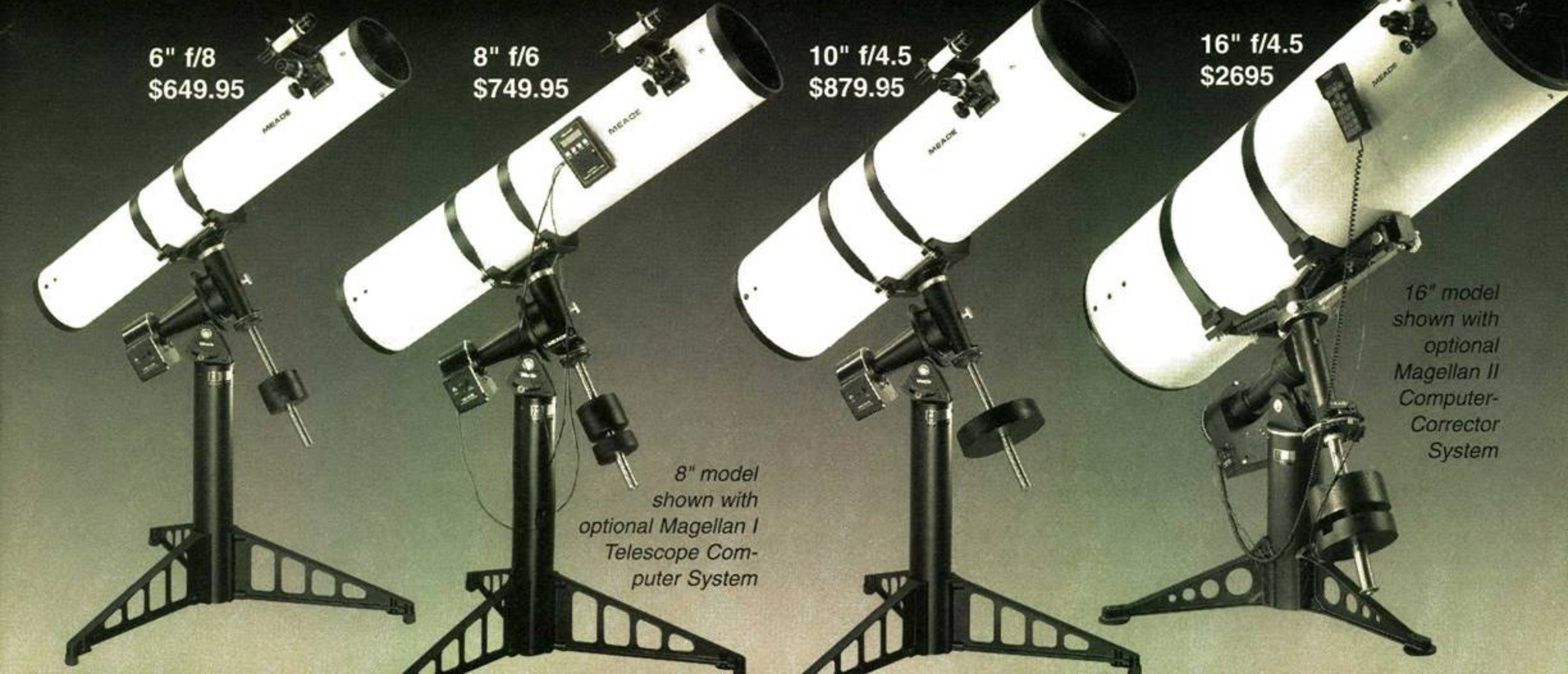
EFSTONSCIENCE, Toronto, Ontario.
Orders & Information: 416-787-4581.

KHAN SCOPE CENTRE, Toronto, Ontario.
Orders & Information: 416-783-4140.

ADVANCED PRODUCTS DIVISION
Meade Instruments Corporation
World's Leading Manufacturer of Astronomical Telescopes for the Serious Amateur
6001 Oak Canyon, Irvine, California 92620 ☐ (949) 451-1450
FAX: (949) 451-1460 ☐ *www.meade.com*

© 1998

STARFINDER EQUATORIAL TELESCOPES ***Shown with standard-equipment 6 x 30mm or 8 x 50mm viewfinder and 2" giant focuser.***



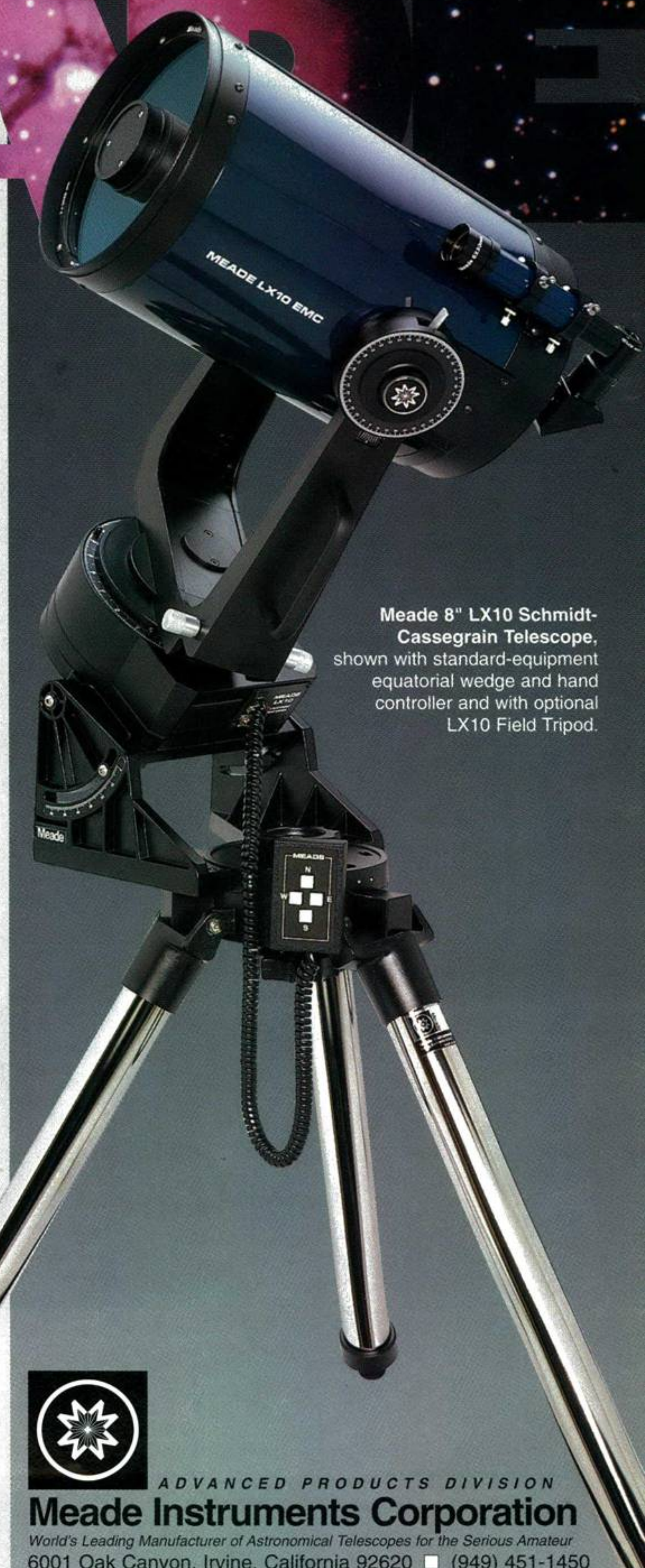
8" model shown with optional Magellan I Telescope Computer System

16" model shown with optional Magellan II Computer-Corrector System

8" LX10

8" LX10 DELUXE

The optical performance of a Meade 8" LX200 Schmidt-Cassegrain...for only *$995!*



Meade 8" LX10 Schmidt-Cassegrain Telescope, shown with standard-equipment equatorial wedge and hand controller and with optional LX10 Field Tripod.

8" LX10: For the serious amateur astronomer on a more limited budget, or for the more casual observer who nonetheless demands the very finest in optical performance, the Meade 8" LX10 satisfies every requirement. *Standard-equipment includes:*

Super Multi-Coated Optical System: The *exact same* multi-coated 8" Schmidt-Cassegrain optical tube assembly as more expensive Meade 8" LX50 and LX200 models. **Equatorial Fork Mounting:** The relatively light weight, but very stable, LX10 fork mounting provides all of the rigidity required for sensitive high-power applications of the telescope, or for photographic or CCD imaging. **Cordless, DC-Powered Electronic Motor Drive:** With electronically-regulated DC servo motor for automatic *sidereal-rate* tracking; powered by four AA-size batteries that fit conveniently through the telescope's control panel; battery life is in excess of 50 hours. **Worm-Gear System:** The LX10's 5.75"-diameter worm gear produces extremely smooth, regular motion in R.A., with low periodic error — a periodic error that permits such advanced capabilities as long-exposure astrophotography or CCD imaging. **Hand Controller:** Essential for micro-guiding the telescope during long-exposure astrophotography, the LX10's pushbutton hand controller enables precise corrections in R.A. at 2x speed. With the optional electric Declination motor added to the telescope, the hand controller is functional at 2x speeds on both telescope axes.

SPECIFICATIONS: 8" Model LX10 — Includes 8" Schmidt-Cassegrain optical tube assembly with EMC super multi-coatings (D = 203mm; F = 2000mm, f/10); fork mount with setting circles, manual slow-motion controls, and locks on both axes; 5.75" LX worm gear reduction system; sidereal-rate electronically-regulated DC servo motor drive; 4-pushbutton hand controller for 2x speed corrections in R.A.; battery compartment accepting four (user-supplied) AA-size batteries (telescope may also be powered from an auto cigarette lighter plug, using optional 25 ft. cord); 6 x 30mm viewfinder; eyepiece-holder and diagonal prism (1.25"); MA25mm multi-coated eyepiece; standard equatorial wedge with elevation scale, fine elevation control, and 360° azimuth orientation capability; complete operating instructions. **$995.** (+ $65 packing & shipping in the 48 states)

8" LX10 Deluxe: At only $1149 the 8" LX10 Deluxe includes (a) the large-aperture Meade #544 8 x 50mm viewfinder (in place of the standard 6 x 30mm finder); (b) a premium-grade Meade Series 4000 Super Plössl 26mm eyepiece (in place of the standard MA25mm eyepiece); and (c) the LX10 Electric Declination Motor System, permitting dual-axis guiding corrections at 2x speed—all at substantially lower cost than if the respective accessories were purchased separately.

SPECIFICATIONS: 8" Model LX10 Deluxe — Identical in all specifications to 8" Model LX10, above, but with Electric Declination Motor System provided as standard equipment, permitting dual-axis corrections at 2x speed; and with Meade #544 8 x 50mm achromatic viewfinder and Series 4000 Super Plössl 26mm multi-coated eyepiece included in place of the 6 x 30mm viewfinder and MA25mm eyepiece of the LX10. **$1149.** (+ $65 packing & shipping in the 48 states)

Field Tripod for LX10 or LX10 Deluxe	**195.**
Electric Declination Motor System for LX10	**95.**
#2014 Magellan I Telescope Computer System for LX10 or LX10 Deluxe, with 12,218-object database	**375.**

The 100-page Meade General Catalog is available free of charge from Meade Instruments or from authorized Meade dealers.
Prices shown are suggested U.S. mail-order prices.

ADVANCED PRODUCTS DIVISION
Meade Instruments Corporation
World's Leading Manufacturer of Astronomical Telescopes for the Serious Amateur
6001 Oak Canyon, Irvine, California 92620 ■ (949) 451-1450
FAX: (949) 451-1460 ■ *www.meade.com*

© 1998

MEADE RESEARCH-GRADE ACCESSORIES

Series 4000™ Super Plössls 52° field; multi-coated

Meade 4-element Super Plössls, updated and redesigned to utilize the latest in optical glass-types, are the finest general-purpose eyepieces available. For observing hairline lunar and planetary detail, splitting close doubles, or for deep-space; guaranteed to deliver more contrast and image sharpness than any other brand. Rubber eyeguards fold down for eyeglass wearers–a feature not available on competing brands. Multi-coated. All focal lengths through 32mm are parfocal.

Super Plössls (SP; 4-elements; 1.25"; 52°):

6.4, 9.7, 12.4, 15, 20, 26mm	each:	**$79.95** (4.54)
32mm (52°); **40mm** (44°)	each:	**99.95** (5.26)
56mm (52°; 2")		**199.95** (7.02)

Series 4000™ Ultra Wide Angle 84° field; multi-coated

The ultimate eyepieces; extreme image sharpness over an amazing 84° field. A perfect optical match with Schmidt-Cassegrains and fast Newtonians.

Ultra Wide Angle (UWA; 8-elements; 1.25"; 84°)– **4.7mm: $169.95** (5.26); **6.7mm: 199.95** (5.26); **8.8mm** (1.25"/2"): **239.95** (7.02); **14mm** (1.25"/2"): **299.95** (7.02)

Series 4000™ f/6.3 Focal Reducer/ Field Flattener

Manufactured to exclusive Meade optical designs; threads on to any Meade or Celestron Schmidt-Cassegrain rear cell and converts f/10 scopes to f/6.3 (or f/6.3 SCT's to f/4), while significantly flattening the field. Use with SCT visual or photo accessories. Actual visual field is increased by 56%, for fine wide-field views of star fields and nebulae. In astrophotography, reduces exposure times by about 50%, while producing an actual field diameter of 1.5" at the film plane. A tremendous aid with CCD imagers in reducing image size for locating and centering images on CCD chips. 4-element optics; multi-coated; 41mm clear aperture. **$129.95** (5.26)

Series 4000 Zoom Eyepiece

The first zoom eyepiece—ever—to yield absolutely uncompromised resolution, color correction, and image brightness. Includes 8 elements, zooms from 7.7mm to 23.1mm with pinpoint imaging from edge to edge. Fully multicoated optics permit 99.8% light transmission at each air-to-glass surface. Apparent field 62° at 7.7mm; fold-down rubber eyecup; threaded for filters; 1.25". **$295.** (7.02)

2x Telenegative Barlow (1.25")

#122: Doubles eyepiece power with sharp, high-resolution, high-contrast imaging on telescopes of all types. 27mm dia. (26mm clear aperture). Excellent corrections for chromatic and spherical aberrations at all photo-visual wavelengths. Multi-coated. 1.25" **$47.95** (4.54)

2x Short-Focus Barlow (1.25")

#126: Only 2.5" long, the #126 works well with any telescope accepting 1.25" eyepieces, even those with limited focus range. Maintains the high image quality of the #122, above. Insert the #126 into star diagonal for 2x or insert star diagonal into #126 for 3x. 26mm clear aperture. Multi-coated. **$47.95** (4.54)

2x-3x Variable Barlow (1.25")

#127: Precision internal sliding lens assembly permits continuously variable power settings between 2x and 3x. Engraved scale indicates power in use. Yields bright, sharp, high-contrast images on telescopes of all types. Multi-coated; 1.25". **$59.95** (4.54)

45° Erecting Prisms

Fully coated roof prisms to invert the astronomical image in Schmidt-Cassegrains or refractors during terrestrial observations, while presenting a convenient 45° observing angle. Specify **#927** (.965"), **#928** (1.25"), or **#931** (fits .965" focuser, accepts 1.25" eyepieces). **$42.95** (3.86)

World's Most Advanced Illuminated Reticle Eyepiece

Series 4000 Plössl 9mm, with rubber eyecup and micrometric X-Y positioning of the reticle within the field. Greatly facilitates locking on the guide star. Sharp high-power imaging, excellent eye relief. Wireless red LED illuminator with adjustable brightness control. Multi-coated optics. **Internal batteries included.** Bullseye reticle. 1.25". **$149.95** (6.14)

Series 4000 Plössl 9mm—Same as above but with 6 ft. cord and plug for Meade LX3, LX5, LX6, LX100, LX200, and APO power panels, in place of wireless illuminator. **$129.95** (5.26)

Series 4000 Photo-Visual Color Filters (1.25")–Premium filters, made of purest crown optical glass, dyed in the mass. For increased contrast and resolution on the Moon and planets. Thread into the barrels of virtually all 1.25" eyepieces sold today. Fully coated.

#8 Lt. Yellow; #11 Yellow Green; #12 Yellow; #21 Orange; #23A Lt. Red; #25A Red; #38A Dark Blue; #47 Violet; #56 Lt. Green; #58 Green; #80A Blue; #82A Lt. Blue each **$14.95** (2.73)

Set #1–4 filters: #12, #23A, #58, #80A	**49.95** (4.54)
Set #2–4 filters: #11, #25A, #47, #82A	**49.95** (4.54)
Set #3–4 filters: #8, #21, #38A, #56	**49.95** (4.54)

Series 4000 Moon Filter (#ND96): Reduces glare and irradiation during lunar observing. 13% uniform light transmission across the visual spectrum. Threads into 1.25" barrels. **$16.95** (2.73)

#905 Variable Polarizer (1.25")

For glare reduction in observing the Moon. Includes two Polarizer filters mounted in a machined cell and permits continuously variable light transmission from 5% to 25%, to compensate for varying lunar surface brightness according to the Moon's phase and the aperture of the telescope. Accepts 1.25" eyepieces. **$49.95** (5.26)

Modified Achromatic Eyepieces

Meade 3-element MA eyepieces yield sharp, well-corrected images on the Moon, planets, and deep-space at a reasonable price. Multi-coated; threaded for filters; 1.25" barrel diameter. Apparent field: 40°. **MA 9, 12, 25, 40mm.** each: **$37.95** (4.54)

MA12mm Illuminated Reticle Eyepiece

Excellent 3-element optical system, long eye relief, fully coated, with double crossline reticle. Wireless red LED illuminator and variable brightness control. 1.25" **Batteries included.** **$99.95** (3.45)

As above but with 6 ft. cord and plug for Meade telescopes with power panels, in place of wireless illuminator. **$79.95** (5.26)

Camera Adapters

Professional-quality adapters for rigid coupling of telescope-to-camera. Use for either Eyepiece-Projection or Prime Focus. Precision-machined of aluminum and brass, threaded for filters. Use with T-mount, available separately.

.965": **$27.95**; 1.25": **$29.95** (3.86)

Variable Tele-Extender

For eyepiece-projection photography with any Meade or Celestron SCT. Threads on to eyepiece-holder. Sliding cell with lock permits wide range of projection magnifications with the same eyepiece. Use with T-mount for your camera. **$39.95** (3.86)

Variable-Projection Camera Adapter (1.25")

Machined sliding cell allows variable projection power in eyepiece-projection photography; permits precise selection of correct photo power in lunar and planetary photography; threaded for filters. Use with T-mount for your camera. **$39.95** (3.86)

T-Adapters for SCT's

Rigidly couples camera to telescope for prime focus photography with any Meade or Celestron Schmidt-Cassegrain. Use with T-Mount for your 35mm camera. **$26.95** (3.86)

Series 4000™ 2x Apochromatic Barlow Lens

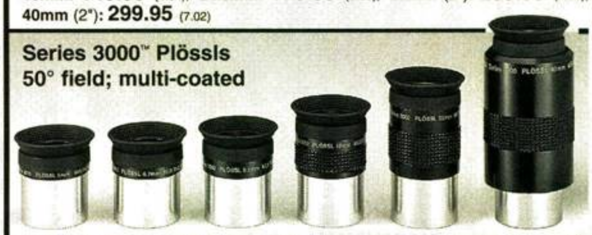
#140: The most advanced Barlow lens available for commercial telescopes, the Meade #140 includes 3-element, multi-coated, air-spaced optics. Doubles the power of any eyepiece with which it is used and yields images absolutely unmatched in resolution, contrast and color correction. The #140 optically complements any telescope — refractor, reflector, or Schmidt-Cassegrain. Accepts 1.25" eyepieces. Mechanical components are of machined aluminum and brass. Lens diameter is 28mm; clear aperture 26mm. **$79.95** (5.26)

Series 4000™ Super Wide Angle 67° field; multi-coated

For exquisite wide-angle images at low-to-medium powers, with pinpoint edge-of-field resolution. Ideal for star fields, galaxies, and other deep-space phenomena. SWA 13.8mm, 18mm, and 24.5mm are superb complements to the #140 Barlow, above.

Super Wide Angle (SWA; 6-elements; 1.25"; 67°)–**13.8mm: $139.95** (4.54); **18mm: 149.95** (4.54); **24.5mm: 179.95** (5.26); **32mm** (2"): **239.95** (7.02); **40mm** (2"): **299.95** (7.02)

Series 3000™ Plössls 50° field; multi-coated



Meade Series 3000 Plössls yield the finest image corrections obtainable from the classical 4-element Plössl design. Focal lengths from 5mm through 25mm are parfocal, so that, at most, only slight refocusing of the image is necessary from eyepiece to eyepiece. Unlike competing moderately-priced Plössls, Meade Series 3000's are **multi-coated** for maximum light transmission and image contrast. Chrome-plated brass barrels are threaded for standard filters. All eyepieces are fitted with fold-down rubber eyecups for comfortable observing. The PL40mm *(far right in photo)*, an excellent complement to any ocular set, produces spectacular low-power, wide fields, ideal for scanning the Milky Way. Manufactured exclusively to Meade optical designs, Series 3000 Plössls yield fine, high-resolution results on reflectors, refractors, and Schmidt-Cassegrains of any focal ratio.

Series 3000 Plössls (4-elements; 1.25"; 50°)

5, 6.7, 9.5, 16, 25mm each: **$49.95** (3.86); **40mm** (44° field): **$79.95** (3.86)

#911B
#910B
#908B
#911N
#910N
#908N

Series 4000 Nebular Filters—Premium multi-layer interference filters, the finest obtainable. Use broadband ("B") filters to block most forms of light pollution; use narrowband ("N") filters in heavily light-polluted areas or for extremely high-contrast observing of faint nebulae.

#908B–Threads into 1.25" eyepieces, 26mm dia.	**79.95** (4.54)
#910B–Threads into 2" eyepieces, 44mm dia.	**119.95** (5.26)
#911B–Threads on to rear cell of Schmidt-Cassegrain telescopes. 36mm dia.	**99.95** (5.26)
#908N–Threads into 1.25" eyepieces, 26mm dia.	**89.95** (4.54)
#910N–Threads into 2" eyepieces, 44mm dia.	**129.95** (5.26)
#911N–Threads on to rear cell of Schmidt-Cassegrain telescopes. 36mm dia.	**119.95** (5.26)

#911X
New!
#910X
#908X

Series 4000 Oxygen-III Filters Observe diffuse emission and planetary nebulae as you never thought possible! Exclusive Meade *60-layer* interference coating technology isolates the 496nm and 501nm O-III lines to tremendously enhance observable nebular structural detail in all telescopes.

#908X–Threads into 1.25" eyepieces, 26mm dia.	**99.95** (4.54)
#910X–Threads into 2" eyepieces, 44mm dia.	**159.95** (5.26)
#911X–Threads on to rear cell of Schmidt-Cassegrain telescopes. 36mm dia.	**149.95** (5.26)

HOW TO ORDER

Prices shown are suggested U.S.A. mail-order retail prices and do not include any applicable sales taxes. Suggested shipping and handling charges to the 48 states by U.P.S. or U.S. Mail shown in ( ) next to each price. **The following national mail-order dealers carry all Meade accessories in-stock for immediate shipment:**

ASTRONOMICS, Norman, OK.
Orders: 800-422-7876; Info.: 405-364-0858.

FOCUS CAMERA, Brooklyn, NY.
Orders: 800-221-0828; Info.: 718-436-6262.

LUMICON, Livermore, CA.
Orders: 800-767-9576; Info.: 510-447-9570.

OCEANSIDE PHOTO & TELESCOPE, Oceanside, CA.
Orders & Information: 800-483-6287.

POCONO MOUNTAIN OPTICS, Moscow, PA.
Orders: 800-569-4323; Info.: 717-842-1500.

RIVERS CAMERA, Dover, NH.
Orders: 800-245-7963; Info.: 603-742-4888.

SHUTAN CAMERA & VIDEO, Chicago, IL.
Orders & Info.: 800-621-2248; IL: 312-332-2000.

Canada:

EFSTONSCIENCE, Toronto, Ontario.
Orders & Information: 416-787-4581.

KHAN SCOPE CENTRE, Toronto, Ontario.
Orders & Information: 416-783-4140.

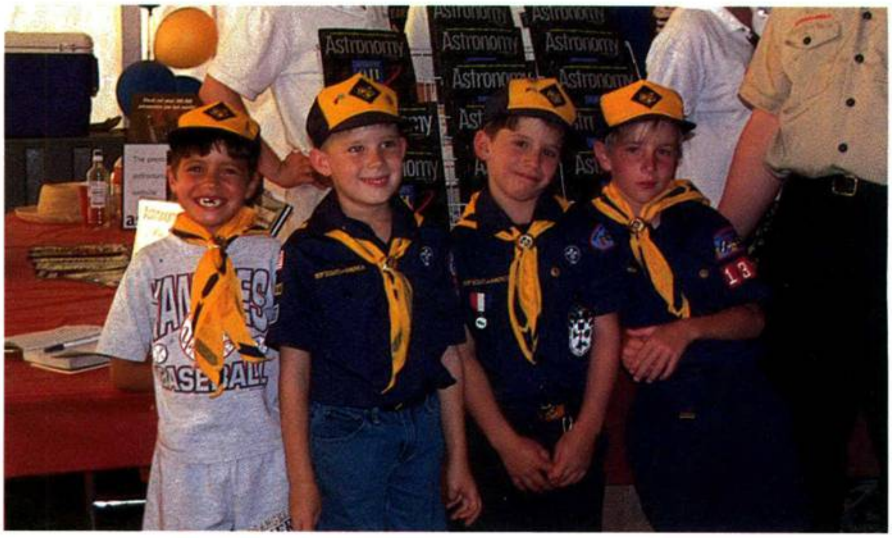
© 1998

(Scenes)
tent. At about 2 p.m., the tent lifted off the ground. That attempted takeoff broke one tent pole and loosened several others. The tentmakers had to be called in to handle the emergency, but we survived. The tent stayed put until closing time.

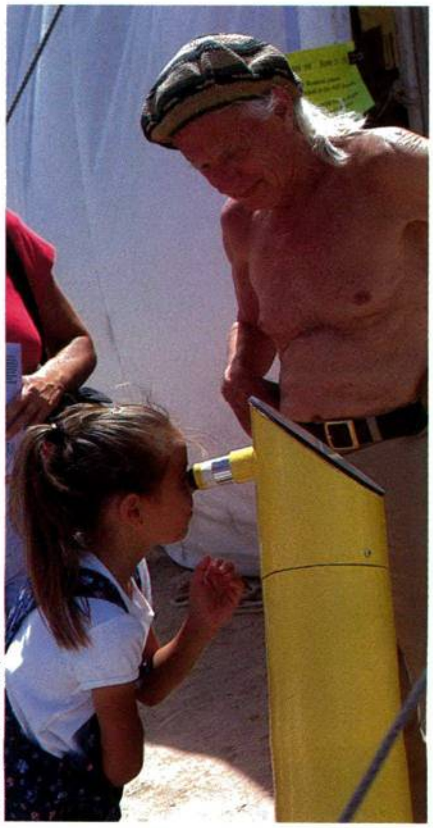
John Dobson, the 84-year-old who changed telescope making forever, was on hand to build one of his scopes and to guide visitors in a look at the sun. Two solar telescopes were popular draws outside despite the wind and dust. Twenty-five artists, photographers and painters, shared their work inside. For six hours, we stayed under cover, kept our heads down when we went outside, or ate grit.

By 4 p.m., we were all a little shell-shocked. Brock Parker, TAAS party organizer and Albuquerque native, tried to calm us. "It must be El Niño," he said. "This is very late in the season for afternoon wind." He assured us that high winds also had dampened spirits before the TAAS Hale-Bopp Comet Party. Perfect party-planner, Rio Rancho recreation specialist Larry Moritomo told us that 17,000 guests had shown for the Hale-Bopp Party anyway. And maybe they did.

By 6 p.m., our winds had begun to slacken. Rockets were launched. By 7 p.m., people were pouring in. Our TAAS volunteers set up hundreds of luminarias to light the hard-to-find entrance to the park. The luminarias, generously made by Albuquerque Girl Scouts, also set off the path from parking lot to telescope field. Inside the tent, two famous comet-hunters, David


Astronomy: Terry Conley

Below: Telescope maker John Dobson shares a solar view with a star party guest. Right: Cub Scouts stop by the *Astronomy* booth. Publisher Russell Larson shares anniversary cake.


Astronomy: Andrea Gianopoulos

Astronomy: Andrea Gianopoulos

Levy and Thomas Bopp, were signing autographs, and folks from all over the country were stopping by to give us their suggestions for improving the magazine.

By nightfall, about 75 telescopes were in place and lines began to form, especially behind the huge Dobsonians. One alluring 41-inch scope carried a tail of potential viewers that curled around the field. At last we could relax. The interviews were over, the cake was cut, the mayor of Rio Rancho, John Jennings, had made an appearance to present a proclamation to publisher Russell Larson declaring it "*Astronomy* Magazine Day" in Rio Rancho. What talking and planning and begging needed doing was done, and we could enjoy Vega, remote galaxies, and the globular clusters along with our guests.

At 7:30 the next morning, Patti Kurtz was in my room reliving the thing. We were happy with the guest list, happy with the true clear skies, happy that we survived what at 3 p.m. looked a bit like complete chaos.

Astronomy: Andrea Gianopoulos

Astronomy: Dave Eicher

Astronomy: Dan Koehler

Above: Associate editor Rich Talcott hangs a few stars before the party begins; *Astronomy* staffers visit party site on June 24. Below: Comet hunter Thomas Bopp, second from left, stops to chat with magazine staff members Patti Kurtz, left, Bonnie Gordon, Robert Naeye, Andrea Gianopoulos, and Dave Eicher.

Because our party was far from chaotic, we want to thank all the folks who attended, and the venders, artists, celebrities, and volunteers. Patti and I especially thank associate editor Andrea Gianopoulos, Brock Parker, and Larry Moritomo, who helped plan the party. We thank TAAS and the Rio Rancho Parks and Recreation Department for cosponsoring many of our activities and giving us exceptional help and support. We also thank the Astronomical Society of the Pacific (ASP) for picking Albuquerque as the site for its great meeting, Universe. We tagged along to attach our star party to that meeting. The ASP supported our efforts wholeheartedly as did the University of New Mexico's Center for Astrophysics. ■

No More Apologies — Just Do the Right Thing

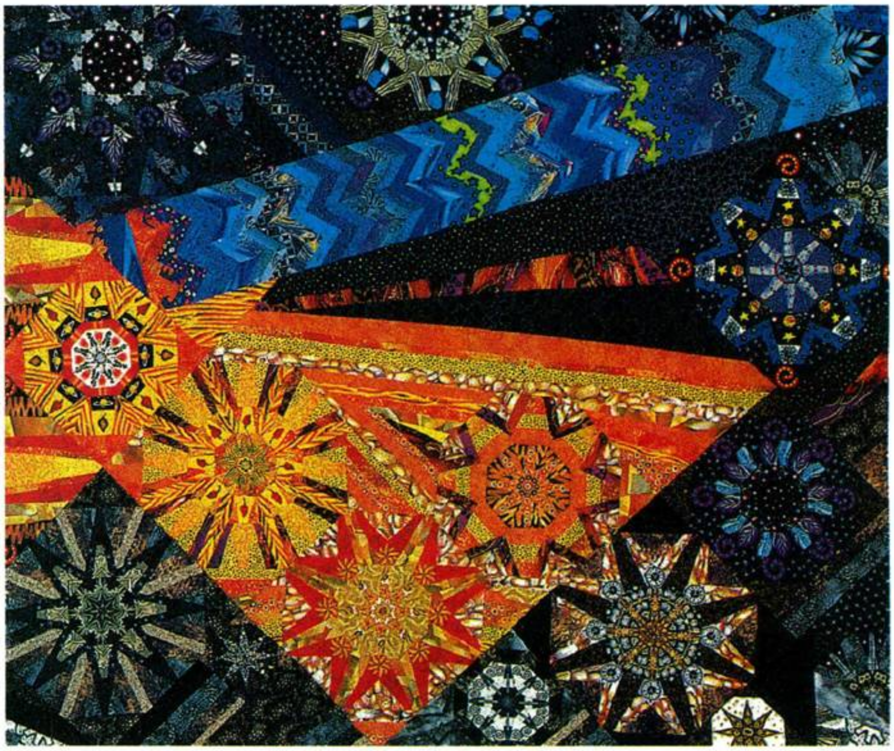
The Vatican's recent tepid and incomplete statement of remorse over the failings of some "sons and daughters of the Church" during the Nazi reign of terror is institutional denial. This Vatican commission statement, prefaced by Pope John Paul II, has been criticized by several Jewish leaders as "too little, too late."

Given the Vatican's history in America, it's no surprise. Native Americans were subjected to papal bulls giving European powers the pope's blessing to "invade . . . capture . . . and subdue all . . . pagans" and "bring them to the Catholic faith . . . under [the Spanish king's] sway."

Those decrees were never formally renounced. And the current controversy over the anniversary of Spanish colonization of the U.S. Southwest also involves the Church, which rode on the coattails of the conquistadors. Albuquerque Archbishop Michael Sheehan has said that now "we want to seek reconciliation for the failings of the past."

The Vatican also came — unbelievably — onto Mt. Graham in Arizona, just ten years ago. Millions were spent in Congress and in court to exempt a mega-telescope project from U.S. Native American cultural and religious (also environmental) protection laws.

How about a reconciliation ceremony with traditional San Carlos Apaches to heal the wounds from the Vatican's telescope construction on the Apache's sacred Mt. Graham? Why not relocate the telescope and ask their fellow German, Italian, University of Arizona, and Ohio State conquistadors to do the same? Must the Vatican keep repeating the same mistakes? — *Paul Roland, Portland, Oregon*


Ann Harwell

"Hale-Bopp/Fractured Symmetry" is a quilt whose inspiration was astronomy.

Quilted Comet

Inspired by *Astronomy's Explore the Universe 1998*, I designed a quilted wall hanging entitled "Hale-Bopp/Fractured Symmetry," measuring 46 inches by 51 inches. Your annual was a terrific reference, and I thoroughly enjoyed both researching and creating "Hale-Bopp." Thanks! — *Ann Harwell, Wendell, North Carolina*

Wow, What a Website!

I was impressed when I found *Astronomy*'s website (http://www.astronomy.com). Your advice on what to look for in telescopes has become my textbook as I recently began my own search. — *Dusty Fenwick, Magna, Utah*

Did History Repeat Itself?

I was doing local historical research recently in old newspaper records on microfilm when I came across an article that instantly reminded me of Comet Shoemaker-Levy 9's encounter with Jupiter.

The article was in the *Washington Post* of August 8, 1933, and its title read "Astronomers Think Meteor Collided with Planet Saturn. Believe Huge White Spot is Cloud of Dust Caused by Blow." Volcanic activity is mentioned as an alternative explanation, but a meteor strike appears to have been the more favored cause. As was the case with Shoemaker-Levy 9, the article on Saturn read, "The dust cloud might be considerably larger than the meteor or eruption that caused it."

I found myself wishing that astronomers of 1933 had the tools their colleagues of today are lucky enough to have — space probes, Keck, Palomar, and the Hubble Space Telescope. As it is, this possible collision must remain forever unverified. — *John Lockwood, Washington, D.C.*

Astronomy *invites you to talk back. Send letters to* Astronomy *Talking Back, P.O. Box 1612, Waukesha, WI 53187; e-mail to talking@astronomy.com. Letters may be edited for space or clarity. If you want to talk back to us, please visit our website, http://www.astronomy.com.*

Astronomy®

KALMBACH PUBLISHING CO.

PRESIDENT
Walter J. Mundschau

EXECUTIVE VICE PRESIDENT
Gerald B. Boettcher

CORPORATE ART DIRECTOR
William R. Edgar

MANAGING ART DIRECTOR
Maureen Schimmel

PRODUCTION MANAGER
Annette Wall

ADVERTISING DIRECTOR
Scott Stollberg

DIRECTOR OF MARKETING
Michael Stephens

ADVERTISING SERVICES MANAGER
Sara Malin Everts

CIRCULATION MANAGER
Shawn Niebeling

CIRCULATION COORDINATOR
Elizabeth Hagon

ADVERTISING DEPARTMENT
(800) 558-1544

ADVERTISING SALES MANAGER
Dan Koehler dkoehler@astronomy.com

ADVERTISING SALES REPRESENTATIVE
Michael Ellis mellis@astronomy.com

AD SERVICES REPRESENTATIVE
Tracy Blonien tblonien@kalmbach.com

NEWSSTAND DISTRIBUTION

U.S. AND INTERNATIONAL
I.C.D., The Hearst Corp., New York, NY 10019

CANADIAN
Telemedia Dist., Toronto, Ontario M4S 3B3

SPECIAL E-MAIL ADDRESSES

Ask Astro askastro@astronomy.com
Star Stuff starstuff@astronomy.com
Talking Back talking@astronomy.com
Hot Shots hotshots@astronomy.com
Customer Service customerservice@kalmbach.com
Ad Sales adsales@astronomy.com

• Telescopes • Binoculars • Biology • Consumer Optics • Photography Accessories •

Educational Science Toys • Geology • Telescopes • Binoculars • Biology • Consumer Optics • Photography Accessories • Telescopes • Binoculars • Biology • Consumer Optics

Do you think of this as the Big Dipper?

Or, a conveniently placed marker for the M-51 galaxy?

The big picture comes into focus when you view it through the Astroscan® 2001. Its unique, cradle-in-your-arm design and ability to glide effortlessly in its table-top base, make it extremely ideal for beginners. Plus, its amazing 3° field and superb light gathering capability make those panoramic views all the more memorable.
Call **800-728-6999** for a free catalog.

Astroscan® 2001, pg 4
$329.00

Edmund Scientific's
SCIENTIFICS
Now Order Toll-Free
800-728-6999

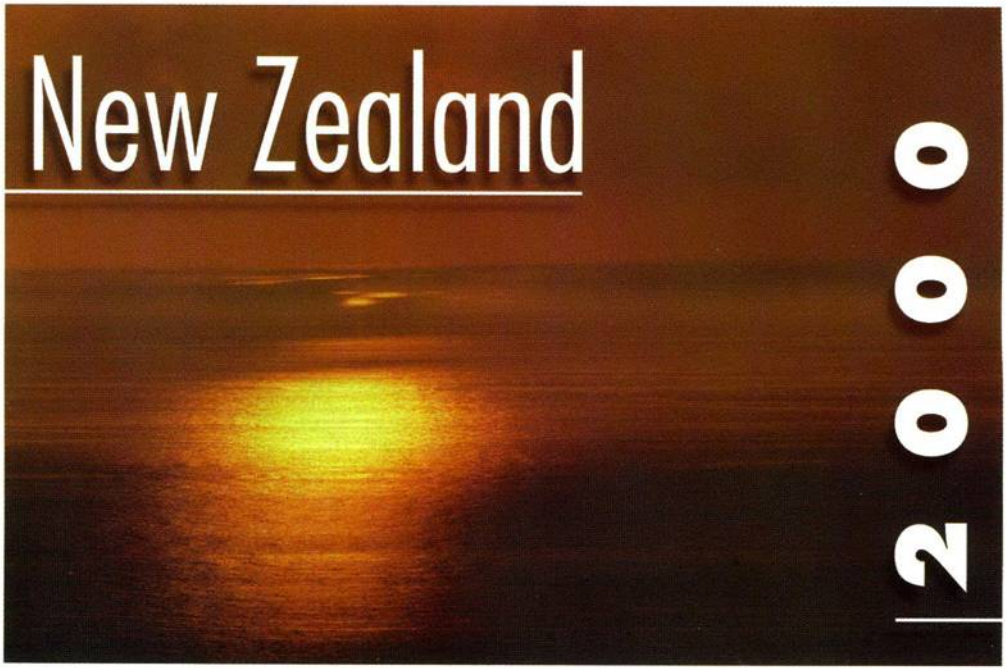
Edmund Scientific
If you love science.

SCIENTIFICS CATALOG DIVISION
Dept. A981C921, 101 E. Gloucester Pike
Barrington, New Jersey 08007-1380
E-mail us at: scientifics@edsci.com

• Telescopes • Binoculars • Biology • Consumer Optics • Photography Accessories •

Astronomy Magazine presents

The Millennium Tour



Join the editors of *Astronomy* on the Millennium Tour of New Zealand and Australia for New Year's Eve 1999. You can ring in the new year with a 12-day trip to the land down under, and be one of the first in the world to see the first sunrise of the year 2000.

You have two tours to choose from depending on the level of physical activity.
Plus, there's a 5-day extension to Australia that includes snorkeling on the Great Barrier Reef.

1 Tour One (for a more active itinerary)

- Climb an active volcano
- Ride the white water rapids
- Tube through the glow worm caves
- Swim with the dolphins
- And other great adventures

2 Tour Two (for a more leisurely pace)

- Climb aboard an overnight sailboat in the fjord
- Travel by helicopter to the top of a glacier
- Take a trip on a hot air balloon
- Ride a train ride through the Southern Alps
- And much more

End this century with a memorable trip! Call Specialty Tours for a brochure today! 1-800-677-9412 or (813) 796-7555

2783-9810

Serious sky-watching made simple
Take the BASIC ASTRONOMY LIBRARY
for only $4.95
as your introduciton to the
Astronomy
Book Club
NORTON'S
STAR ATLAS
AND REFERENCE HANDBOOK
NINETEENTH EDITION
EDITED BY
IAN RIDPATH
Updated Edition
YOUR GUIDE
TO THE SKY
RICK SHAFFER
PRACTICAL
ASTRONOMY
A User-Friendly Handbook for Sky Watchers
H. Robert Mills
A
$107.85
Value!

You simply agree to buy three more books — at significant savings — within the next 12 months.

The BASIC ASTRONOMY LIBRARY will help you launch your exploration of the stars by providing you with a comprehensive astronomer's tool kit:

- **A trusted star atlas**
- **A hands-on viewing guide**
- **And a practical manual packed with tips and techniques you can use to navigate the heavens**

NORTON'S STAR ATLAS AND REFERENCE HANDBOOK, 19th Edition

Edited by Ian Ridpath

Trusted by generations of astronomers. Norton's is the premier star atlas and reference handbook. Reflecting the latest developments in observational astronomy, this fully revised and updated edition gives you star maps replotted to a new level of accuracy for the standard Epoch 2000.0. The maps are divided into sections with accompanying lists of interesting objects, and display all stars visible to the naked eye, as well as star clusters, nebulae, and galaxies. 57 tables include sunrise and sunset times, disappearances of Jupiter's satellites, and lunar and solar eclipses through 2004. 192 pages. Publisher's Price $59.95

PRACTICAL ASTRONOMY
A User-Friendly Handbook for Sky Watchers

By H. Robert Mills

This hands-on manual gives practical hints and techniques on using telescopes, binoculars and star-charts, understanding lenses, taking measurements — and much more — all with simple instructions, photographs, and diagrams. You'll learn how to plot star positions and how to build observing instruments, such as a sextant, sundial, and star globe. Extensive Appendices offer advice on observing and record-keeping.

236 pages. Publisher's Price $29.95

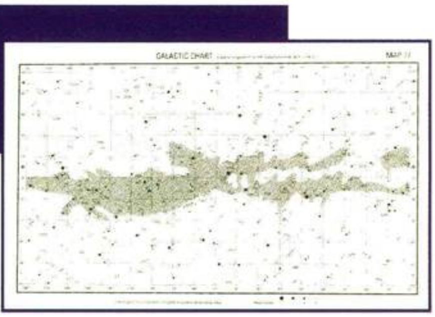
YOUR GUIDE TO THE SKY, Updated Edition

By Rick Schaffer

"An ideal introduction to amateur astronomy for anyone." —Robert Burham, editor, *Astronomy*

Arranged around 24 computer-generated, low distortion star maps, this volume gives you easy-to-follow images of the night sky. A descriptive text accompanies each map, while special zoom maps highlight a fascinating feature each month. Your Guide To The Sky also provides a table with upcoming meteor shower dates and a special Mini-Almanac to help you pinpoint the planets each month.

176 pages. Publisher's Price $17.95

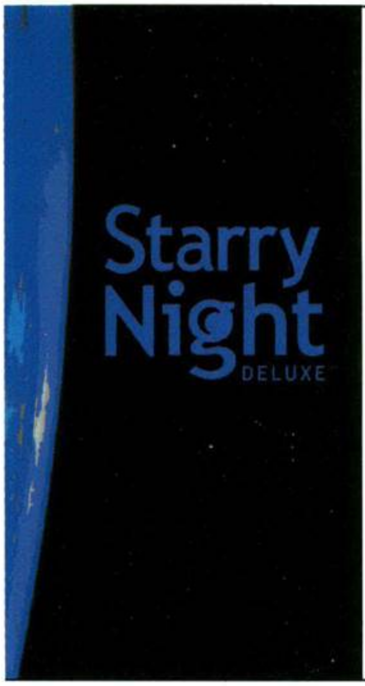


About the Club

Whether you're a professional or amateur enthusiast, the Astronomy Book Club offers you the finest astronomy materials available. You'll enjoy practical observing handbooks, atlases and how-to manuals, as well as general texts, in-depth investigations into topics on the frontiers of astronomy and astrophysics, and popular guides covering the latest discoveries. All books are available to you at significant savings, with prices starting as low as $12.95.

MEMBERSHIP BENEFITS In addition to getting the BASIC ASTRONOMY LIBRARY for only $4.95 when you join, you keep saving substantially with discounts of up to 50% off the publishers' prices on books you choose to purchase. • Your only commitment is to purchase three more books at the regular member's price during the next 12 months. After that, you're free to cancel your membership. • Also, with your first purchase of one regular selection, you'll earn Bonus Credits you can use to save even more. • When you qualify as a Preferred Member, you'll earn *double* Bonus Credits and enjoy other special benefits. • Moreover, we feature quality publishers' editions. Also, from time to time, you'll be able to purchase special book club editions at significant savings. • At 3-4 week intervals (15 times per year), you will receive the Astronomy Book Club News, describing the coming Main Selection and Alternate Selections, together with a dated reply card. Plus, up to three times a year, you may receive offers of Special Selections which will be made available to a group of select members. • If you want the Main Selection, do nothing, and it will be sent to you automatically. • If you prefer another selection, or no book at all, simply indicate your choice on the card and return it by the date specified. • You will have at least 15 days to decide. If, because of late mail delivery of the News, you should receive a book you do not want, just return it free of charge.

If reply card is missing, please write to Astronomy Book Club, Dept. L-EA8/00840, 3000 Cindel Drive, Delran, NJ 08370-0001, for membership information and an application.
Astronomy 11/98



WHERE DO YOU WANT TO GO
...TONIGHT?

From your own backyard, to anywhere in the solar system, go there with Starry Night Deluxe.

Award Winning Astronomy Software
Easy enough for beginners
Powerful enough for serious enthusiasts

Order Today Toll Free!
(877) STARS-88
(877) 782-7788
Fax(416) 410-0359
Just $89.95 + shipping

Download the Demo!
WWW.SIENNASOFT.COM
Window 95/NT, Mac OS

sienna™

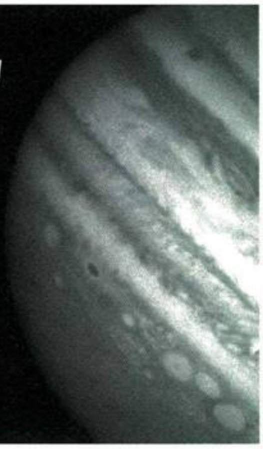
F. C. Meichsner Co., Inc.

Our 81 years of experience and knowledge will help you get the best optics for your money!

- ☆ Celestron
- ☆ Meade
- ☆ Tele Vue
- ☆ Takahashi
- ☆ Questar
- ☆ Miyauchi
- ☆ Fujinon
- ☆ Nikon
- ☆ Swift
- ☆ Bushnell
- ☆ Used Equipment
- ☆ Repair Service
- ☆ Large Showroom
- ☆ Worldwide Shipping
- ☆ Free Price List

☆ Accessories Always in Stock • Call for Monthy Specials

***Call us at:* (800) 321-VIEW! (8439)**
Fax: 617-426-0837 (24 hours)
E-Mail: Meichs@aol.com
***Visit us at:* 182 Lincoln Street, Boston, MA 02111**
Web site: http://www.meichsner.com



October 8-11, 1998
Socorro,
New Mexico

The Star Party with:
- Clear, dark skies
- Outstanding speakers
- Spectacular tours
- Genuine Southwestern scenery and culture

NEW MEXICO
LAND OF ENCHANTMENT

The 5th Annual
Enchanted Skies Star Party

Astronomy in the Great American Southwest

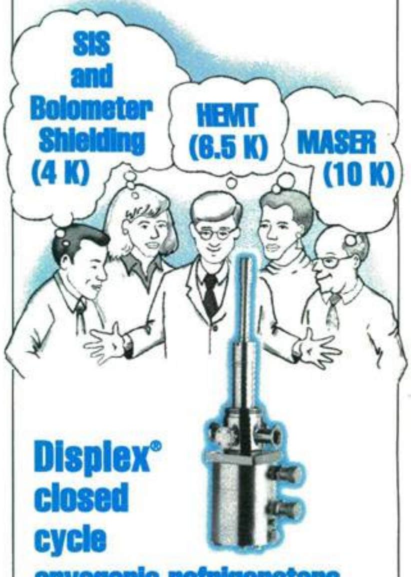
Join us for observing fun, door prizes, friendly competitions, our famous chuck-wagon dinner, and tours of area scientific facilities. Our renowned lecture series features presentations by amateur and professional astronomers on topics ranging from beginning to advanced observing techniques and the latest news from the cutting edge of science.

The Enchanted Skies Star Party offers a unique experience in Southwestern astronomy. A dry, desert climate, dark skies and Socorro's friendly, small-town environment provide excellent observing and a relaxing atmosphere.

The Enchanted Skies Star Party
P.O. Box 743-A
Socorro, NM, 87801
505-835-0424

www.socorro-nm.com/starparty.html

The Radio Astronomy Cryogenic System


SIS and Bolometer Shielding (4 K)
HEMT (6.5 K)
MASER (10 K)

Displex® closed cycle cryogenic refrigerators are designed and manufactured with four decades of experience. They are the industry standard in markets such as laboratory research and are now available to you:

- Extremely high reliability
- Cooling capacities from 4 - 800 Kelvin
- Only two moving parts in the cold end for fast and easy maintenance
- Compressors designed specifically for helium consumption

Displex - The Name In Cryogenic Cooling

IGC APD Cryogenics Inc.
A Subsidiary of Intermagnetics General Corporation

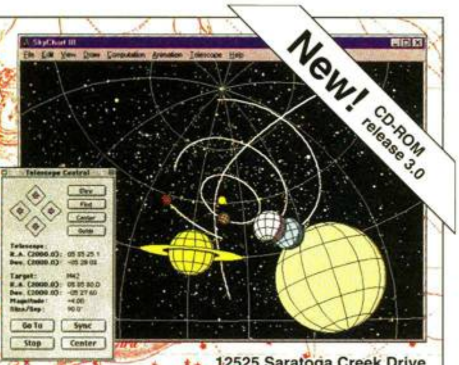
1833 Vultee Street
Allentown, PA 18103 U.S.A.
phone: (610) 791-6700
or within the U.S.A.: (800) 525-3072
fax: (610) 791-0561
e-mail: sales@apdcryogenics.com
internet: http://www.apdcryogenics.com

SkyChart III

Precision Sky Simulator
for Windows and Macintosh

- Editable 19-million-object database with milliarcsecond accuracy
- Artificial satellites
- Telescope control
- ... and much more!

$39.95 + tax & shipping



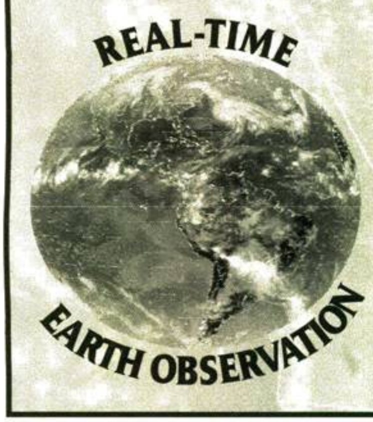
Telescope:
R.A. (2000.0): 05 35 25.1
Dec. (2000.0): −05 28 08

Target: M42
R.A. (2000.0): 05 35 30.0
Dec. (2000.0): −05 27 60
Magnitude: +4.00
Size/Sep: 90.0'

SOUTHERN STARS SOFTWARE
Professional Software for the Amateur Astronomer

12525 Saratoga Creek Drive
Saratoga, CA 95070
Phone & Fax: 408-973-1016
E-mail: info@southernstars.com
Web: www.southernstars.com

REAL-TIME EARTH OBSERVATION



Now you can receive wireless real-time images from Earth orbiting weather satellites on your PC. Images are relayed over shortwave radio and transmitted directly from the satellites. SSC makes hardware and software products that let you receive, decode, display and process these images.

If you need to see if it is worth trekking to a remote obeserving site, track storms, study global weather or just enjoy watching the world go by, SSC has a package for you.

Decoders start as low as $179.95. Complete satellite ground stations start at only $529.95. Call or write for a FREE catalog.

Software Systems Consulting
615 S. El Camino Real, San Clemente, CA 92672
Tel: (714) 498-5784 • Fax: (714) 498-0568
E-mail:support@ssccorp.com • http://www.ssccorp.com

WHAT IN THE WORLD

LOCATED IN LAKE ARROWHEAD'S DARK MOUNTAIN SKIES
Orders: (888) What world – (888) 942-8967
Info: (909) 337-5080

TELESCOPES, CAMERAS AND ACCESSORIES
FULL LINE DEALER FOR
BAUSCH & LOMB, CELESTRON,
MEADE, SBIG, TAKAHASHI & TELE VUE

NEW!

FROM $39.95
ACCU-FOCUS™ (PAT.PEND.) COLLIMATE AND FOCUS PRECISELY.

TELESCOPES

Dobsonians from 4.5" to the NEW 17.5"	from $349
Meade and Celestron Schmidt Cassegrains from 8" to 16"	from $995
Maksutovs	$CALL
BIG Selection of **Meade and Celestron** Small Refractors	from $79
Takahashi Refractors, Mewlons and Epsilon Astrographs	from $910
Tele Vue NEW 85 mm, Pronto and Ranger	$CALL

AO IMAGE FROM THE *WHAT IN THE WORLD* OBSERVATORY

ACCESSORIES

Tele Vue Eyepieces	$CALL
Series 3000 Eyepieces	from $49.95
Series 4000 Eyepieces	from $79.95
Plossl Eyepieces	from $49.99
Ultima Eyepieces	from $79.95
Filter Sets	from $52.50
Telrad	$44.99
Barlows	from $51.40
Fastar 8"	IN STOCK

NEW!!!! Canon Image Stabilized Binos!!!

Celestron 20x80's Std & Dlx	$CALL
10x50 Powerview WA	$57.99
12x50 Powerview WA	$61.95
B & L Custom 10x40 Armor	$359.99
B & L Elites	$CALL

Davis Weather Stations...In Stock

CCD CAMERAS/ACCYS

SBIG ST7/8 from	$2650
SBIG AO-07 Adaptive Optics	$CALL
Meade	$CALL
Apogee AP7, AP8	$CALL
Isis Filter Wheel FW-1	$CALL

SOFTWARE/COMPUTER

The Sky Level II, III, IV	$CALL
CCDSoft	$CALL

WE HAVE MOST CCD CAMERAS & ACCESSORIES IN STOCK
WE OPERATE A MILE HIGH REMOTE CONTROLLED OBSERVATORY
ALL PRICES PLUS PACKING & SHIPPING NOT RESPONSIBLE FOR TYPOGRAPHICAL ERRORS

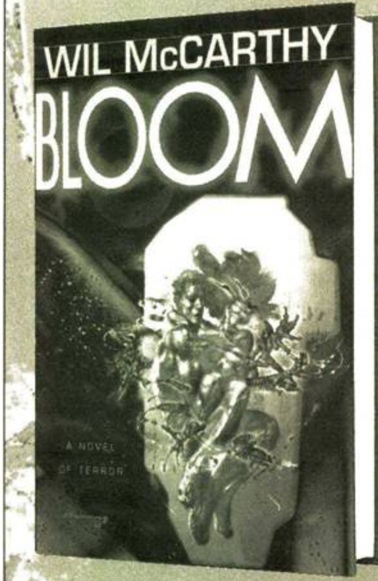
We gladly accept

Please call for all other accessories & models!
OPEN 7 DAYS • 10 A.M. TO 5:30 P.M. PACIFIC

WHAT IN THE WORLD
Nature • Science • Recreation • Environment

P.O. Box 1767 • 28200 Hwy. 189, Suite E210 • Lake Arrowhead, CA 92352
Phone: (909) 337-5080 • FAX: (909) 336-9708
Website at http://www.whatintheworld.com
Call for Complete Catalog & Newsletter

It's the end of the world... as *we* know it.



It's insidious.
It's indestructible.
And it's *infinite.*

A man-made organism will be man's unmaking.

"What clever and compelling science fiction! The '*Bloom*' future is all too believable."
—James Gleick

DEL REY

On Sale Now
Stories That Define Imagination
The Ballantine Publishing Group

Reader Reviews Contests Special Offers *Free* newsletter
www.randomhouse.com/bloom
Free book previews Inside information Author interviews

ORION TELESCOPES & BINOCULARS

Our 23RD Year!

Buy From the Largest Direct-to-Consumer Source for Astronomical Gear in North America!

TELESCOPES

The New SkyView™ Deluxe EQ Series

Features, Performance, and Value That Eclipse the Competition

ORION

NEW!
Motor Drive Compatible!
NEW!
NEW!

SkyView™ Deluxe 6" EQ Newtonian

Meet the new "gold standard" for value in the 6" equatorial reflector class. At its heart is a high-precision 6"-diameter **parabolic** primary mirror – not a lesser-performing spherical mirror as you get with some competitive 6" Newtonians. Rolled steel optical tube. Focal length 750mm (f/5).

$599

SkyView™ Deluxe 4.5" EQ Newtonian

An exquisite combination of form, function, and affordability for the serious beginning astronomer. The rolled steel optical tube houses a precision-polished 4.5" primary mirror of 900mm focal length (f/7.9).

$459

SkyView™ Deluxe 90mm EQ Refractor

Exceptionally crisp views of the Moon, planets, and beyond! Multi-coated 90mm achromatic objective lens of 1000mm focal length (f/11.1). Seamless aluminum optical tube.

$549

Outfit your SkyView Deluxe with an AccuTrack™ DC Motor Drive for automatic star tracking.

$99

Look What's Included!

- ***New heavy-duty EQ mount***
- ***Built-in polar-alignment scope***
- ***TWO 1.25" Plössl eyepieces***
- ***6x30 achromatic finder scope***
- ***Moon filter (1.25")***
- ***Gold-anodized aluminum tripod***
- ***Compare to competing brands, then compare the prices!***

Featuring the New SkyView™ Deluxe Equatorial Mount

With Built-in Polar-Alignment Scope!

Each SkyView Deluxe telescope is equipped with this rock-stable precision equatorial mount. It features fully enclosed worm gears and dual, high-visibility setting circles. Built-in reticle bore scope makes polar alignment a snap! Dual micro-motion cables, large lever-type RA and Dec lock knobs, azimuth fine-adjustment, and latitude scale.

FREE CD-ROM

The perfect guide to the sky for new telescope owners!

Requires PC running Windows 95 or 3.1x operating system.

An $89 Value

with purchase of any Orion astronomical telescope!

Where The Stars Are

ORION

ShortTube™ 4.5" EQ Reflector

A highly portable, affordable beginner's scope with all the power and light-gathering of a longer 4.5" Newtonian. Equatorial mount with dual slow-motion controls. Includes two 1.25" Kellner eyepieces: 25mm (40x) and 10mm (100x). Adjustable wood tripod with accessory tray. Effective focal length 1000 (f/8.8).

$249

New Lower Price!

ORION

ShortTube™ 80mm Rich-Field Refractor

Rich-field 400mm f.l., f/5 scope excels for casual observing and prime-focus astrophotography. 6x30 finder, 1.25" rack-and-pinion focuser, 45° erect-image diagonal, and TWO 1.25" Kellner eyepieces. Mounts on a photo tripod or equatorial mount (sold separately). Makes a terrific guide scope, too!

~~$249~~ $229

Argonaut™ 150mm EQ Maksutov-Cassegrain

The design heralded for its extraordinary image quality is now very affordable. Now comes with precision SkyView Deluxe equatorial mount and gold-anodized aluminum tripod. Effective focal length is 1800mm (f/12), 150mm (nearly 6") aperture. Gearless Crayford 2" focuser, 7x35 achromatic finder, and padded case for OTA.

$1099

Star diagonal and eyepiece sold separately.

VX120 GP 120mm (4.7") Refractor

We're breaking out the big gun! The VX120 has enough clear aperture—4.7"—to deliver exceptionally bright, high-definition views of deep-sky subjects, not just solar system fare. Its 4-element, 2-group objective achromat provides added color correction and field flattening. Relatively fast f-ratio of 6.7 (focal length 800mm) gives it awesome astrophotographic capabilities. GP equatorial mount insures high operating precision and stability. R&P focuser, 7x50 finder scope, prism star diagonal, and 20mm (40x) Lanthanum eyepiece (1.25") come standard.

$1999

Deep Space Explorer™ Dobs

The Dobs *S&T* called a "best buy" are now an even better value! New rack-and-pinion focuser, four-vane secondary mirror support for more precise collimation, larger handle on the Dobsonian base, and black tube finish. Standard accessories include a 25mm Explorer II eyepiece (1.25") and 5x finder scope. Bonus Accessory Package available.

6" (f/8)	$359
8" (f/6)	$469
10" (f/4.5)	$699

ORION

VX102-ED GP Refractor

ORION by Vixen

This compact "apo" refractor features a 2-element objective utilizing extra-low dispersion ("ED") glass, for dramatically improved color correction. Its 665mm focal length and fast f/6.5 f-ratio make it a superb instrument for wide-field, deep-sky photography. Rides on the venerable GP equatorial mount and aluminum tripod. 6x30 finder, star diagonal, illuminated polar-alignment scope, and 20mm (33x) Lanthanum eyepiece (1.25").

$1999

Other VX102 Refractors

VX102 GP (f/9.8)	$1199
VX102-FL (f/9.0)	$2499

Shown with optional SkySensor 2000.

ORION by Vixen

R200SS GP 200mm Newtonian

The ultimate reflector features big 200mm (7.9") primary mirror in an aluminum tube only 27" long! Short 800mm focal length makes this a super-fast f/4 system, excellent for wide-field viewing and astroimaging. Includes 6x30 finder, 26mm (31x) Sirius Plössl eyepiece (1.25"), precision GP equatorial mount, and aluminum tripod. Optional motor drives, SkySensor "Go To" system, and many other accessories available.

~~$1499~~ $1299

MONEY-BACK GUARANTEE

If you are not completely satisfied with your purchase from Telescope & Binocular Center

100% Satisfaction

for any reason, just return it in new condition within 30 days after delivery for a prompt refund.

Visit one of our California Retail Stores!

Some prices in retail stores may vary.

San Francisco • 3609 Buchanan St., at Bay, 1 block from Marina Safeway • (415) 931-9966

San Jose-Cupertino • 10555 S. De Anza Blvd., at McClellan: from Hwy 280, take De Anza exit; from Hwy 85 take De Anza or Stevens Creek exit • (408) 255-8770

Monterey Bay-Watsonville • 89 Hangar Way, off Airport Blvd. near Santa Cruz • (831) 763-7000

24 Hour Toll-Free Orders: (800) 447-1001

Information/Advice: (800) 676-1343

Information Line Hours: M–F 5am–9pm, SAT. 8am–6pm PACIFIC TIME

www.oriontel.com

BINOCULARS

ORION

Little Giant™ II 70mm Binocular

More compact than the original Little Giants, and now three different powers to choose from–up to 20x! Big 70mm objectives reveal a plethora of nebulous clouds and stellar clusterings. Great for twilight and daytime use too. Sharp, fully multi-coated optics with BAK-4 prisms and centered lenses. Large, knurled center focus wheel. Classic black coarse-grain finish provides a sure grip. Tripod L-adapter, case, and deluxe wide neck strap included. Made in Japan.

11x70 Little Giant II	15x70 Little Giant II	20x70 Little Giant II
Field of view 4.5°	Field of view 4.0°	Field of view 3.0°
		$269

Vixen

80mm Binocular Telescope

Looking through TWO premium-quality 80mm (3.1") refractors simultaneously is an unforgettable experience! Uses interchangeable 1.25" telescope eyepieces, allowing wide range of powers! Includes two 25mm eyepieces (36x, 1.1° field). Mount/tripod sold separately.
$879

INTERCHANGEABLE EYEPIECES!

Custom D Altaz Mount/Tripod
Recommended for Vixen BT80.
$445

Canon

Image Stabilizer Binoculars

"ASTOUNDING! . . . . TRULY A QUANTUM LEAP IN BINOCULAR OBSERVING." — SKY & TELESCOPE (5/98)

Enjoy hand-held, high-power binocular viewing without shaky images! Special microprocessor-controlled prisms provide rock-steady views. You'll see fainter objects and much more detail. *S&T* raved: "The price and proven performance of the Canon binoculars will certainly make them a hot item for amateur astronomers." Fully multi-coated optics, tack-sharp images edge to edge.

SALE!

10x30 IS	12x36 IS	15x45 IS
Field of view 6.0°.	Field of view 5.6°.	Field of view 4.5°.
~~$629~~ $599	~~$949~~ $899	$1399

ORION

Scenix™ 50mm

High-Quality Binos Can Be Affordable

Rugged, all-metal construction with sure-grip rubber armor. Fully coated with extra multi-coatings on the objectives. BAK-4 prisms. Tripod adaptable.

7x50, 10x50 WA $89.95

ORION

UltraView™ 50mm

Best Bino Available For Eyeglass Wearers

Extra-long 22mm eye relief and unique pop-down eyeguards. Fully multi-coated. BAK-4 prisms. Tripod adaptable.

7x50, 10x50 WA $179

ORION

SALE!

Vista™ 50mm

Featherlight High-Performance Binoculars

High-index BAK-4 prisms and fully multi-coated optics for high-fidelity images. Soft leatherette covering. Tripod adaptable.

7x50, 10x50 ~~$219~~ $199

ORION

New Lower Price!

Mini Giant™

Large Apertures in Compact Bodies

Great astro binoculars! Fully multi-coated optics, BAK-4 prisms. Long 18mm eye relief. Tripod adaptable.

8x56 ~~$179~~ $159
9x63 ~~$219~~ $189

ORION

Giant 80mm

Enjoy stunning resolution. Fully multi-coated optics with BAK-4 prisms. Objective bridge for added rigidity. Center focus. Tripod L-adapter included.

11x80 Giant
4.5° field, 16mm eye relief.
16x80 Giant
3.5° field, 16mm eye relief.
20x80 Giant
3.5° field, 15mm eye relief. $399

ORION

SuperGiant™ 100mm

Gigantic 100mm (almost 4") lenses for unbelievably detailed views of the heavens! Fully multi-coated optics with BAK-4 prisms. Platform-type mounting plate included.

SALE!

14x100 SuperGiant
Individual focus. 3.3° field, 14mm eye relief.
~~$1249~~ $1049

25x100 SuperGiant
Center focus. 2.6° field, 10mm eye relief.
~~$1249~~ $1099

EYEPIECES & ACCESSORIES

Sirius™

Sirius Plössl Eyepieces

You could pay twice the price for other brands of Plössl eyepieces, but why? Sirius Plössls are top-quality, 50° apparent-field (43° 40mm) eyepieces that yield extremely sharp images of impressively high contrast. Ideal for all types of telescopes. Fully-coated optics, rubber eyeguards. Stock up today!

1.25"
6.3mm, 7.5mm, 10mm, 12.5mm, 17mm, 20mm, 26mm $49.95 each
32mm, 40mm $59.95 each
.965"
6.3mm, 7.5mm, 10mm, 12.5mm, 17mm, 20mm, 26mm $49.95 each

ORION

SALE! $10 OFF Each

Ultrascopic Eyepieces

The highest contrast and light transmission obtainable. Superior 5- or 7-element design with Ultra Multi-Coatings on every surface. Wide 52° apparent field. Removable winged rubber eyeguard. Threaded for filters. 1.25" barrels.

3.8mm, 5mm, 7.5mm, 10mm, 15mm, 20mm, 25mm, 30mm, 35mm
From ~~$79~~ $69

Illuminated Reticles, wireless

5mm Ultrascopic	$159
10mm Ultrascopic	$139
12mm Kellner	$99.95
12.5mm Plössl	$129

ORION

NEW!

Lanthanum 65° Superwides

Combining long 20mm eye relief, an expansive 65° apparent field, and a rare-earth lanthanum lens element for superior image correction, these oculars are an astronomer's dream come true. Eight lens elements, multi-coated. 1.25" barrel.

8mm	$205
13mm	$214
17mm	$222
22mm	$222

Vixen Lanthanum Eyepieces

Long 20mm eye relief. Apparent field 50° (9mm-15mm) or 45° (2.5mm-6mm). 1.25" barrels.

2.5mm, 4mm, 5mm, 6mm, 9mm, 10mm, 12mm, 15mm, 8-24mm zoom
From $134

ORION

Explorer II Eyepieces

Attractively priced for even limited budgets. Their 3- and 4-element fully coated glass lens configurations provide a 50° apparent field of view. Threaded for filters.

1.25"
6mm, 10mm, 13mm, 17mm, 25mm
$34.95 each
.965"
6mm, 10mm, 13mm, 17mm, 25mm
$29.95 each

Equatorial Mounts

NEW!

Orion SkyView Deluxe
Extra-sturdy equatorial head. Enclosed worm gears, slow-motion cables, plus a built-in polar-alignment scope! Unique gold-anodized aluminum tripod.
$239

EQ Mount w/Wood Tripod
$139

Great Polaris (GP)
$699

Great Polaris Deluxe (GP-DX)
$999

New Lower Price!

Shorty™ 2x Barlow Lens

Doubles the power of any eyepiece.

.965"	~~$49.95~~ $44.50
1.25"	~~$49.95~~ $44.50

Collimating Eyepiece

Combination Cheshire eyepiece and sight tube. Essential for optimizing performance of fast Newtonians. Anodized aluminum.
$34.95

Filters

Lunar (.965", 1.25")	$15.95
SkyGlow Broadband LP	From $44.95
UltraBlock Narrowband LP	From $79.95

Full-Aperture Solar Filters

Many different sizes in stock.
From $54.95

Color Filters

Sold individually or in sets. CALL

Dew Zapper

Electrical contact heater keeps dew from forming. Sizes to fit popular Schmidt-Cassegrains. DC or AC.
From $37.95

SALE! $10-$20 OFF

Finder Scopes/Reflex Sights

EZ Finder Reflex Sight
$39.95

ORION EZ Finder

6x30 Achromatic
$39.95

8x50 NonIlluminated	$74.95
8x50 Illuminated	$119
9x60 Nonilluminated	$109
9x60 Illuminated	$159
Dual-Ring Bracket for 8x50	$34.95
Dual-Ring Bracket for 9x60	$39.95

Power Station

Rechargeable DC field battery.
$69.95

Accessory Cases

Small Case	$19.95
Medium Case	$27.95
Large Case	$44.95

Soft Cases for Telescopes
For many different models.
From $38.95

Motor Drives

AccuTrack DC Drive for SkyView Deluxe EQ Mount	$99
AC Motor Drive	$84.95
R.A. Motor w/ Hand Controller	$199
Optional Dec Motor	$99.95
Vixen GP R.A./Dec. Motor	$99
Vixen Single-Axis Controller	$119
Vixen Dual-Axis Controller	$199

Orion's DeepMap 600™

Tired of looking at the same old objects? This quick-reference, full-color, folding star map shows where to locate 600 of the finest objects in the northern heavens with a backyard telescope. Visual data and description for every object. Printed on waterproof, no-rip plastic. 33" x 21"
$13.95

EZ Balance™ Sliding Counterweight for Dobs

NEW!

Your Dob will always be in balance! Steel weight slides on dovetail track.

EZ Balance with 1-lb. weight	$49.95
EZ Balance with 2.5-lb. weight	$59.95

6-Piece Optics Cleaning Kit

$12.95

More than 1000 products in our print & online catalogs!

ORION TELESCOPES & BINOCULARS
SkyView Deluxe EQ Series
The New Gold Standard in Backyard Scopes
23
Improved features
Enhanced performance
Unrivaled value

ORION
TELESCOPES & BINOCULARS
P.O. BOX 1815, SANTA CRUZ, CA 95061

FULL ONLINE CATALOG
www.oriontel.com

IT'S EASY TO ORDER!

- Call toll-free and charge to your Discover/Novus, MasterCard, or VISA Card, or send your personal check to order by mail. Mail Orders to: P. O. Box 1815-A, Santa Cruz, CA 95061-1815. Fax Orders to: (831) 763-7017
- California residents add 7.25% sales tax (8.25%) in Santa Clara County; 8% in Santa Cruz County, 8.5% in San Francisco).
- Shipping and handling charges additional. Call for rates. Expedited delivery available. We ship worldwide; some restrictions apply.
- For catalog requests outside the U.S. or Canada, send $5 in U.S. funds.
- Prices are subject to change or correction without notice.

FREE 100-PAGE CATALOG CALL (800) 447-1001

MasterCard DISCOVER NOVUS VISA

When ordering, mention key code RMA

EXTRASOLAR PLANETS

Two New Planets Revealed

Closest known planet to solar system discovered

▶ After a year-long hiatus, astronomers are reporting two new planet discoveries. One of the planets orbits the star Gliese 876, just 15 light-years away. "This star is by far the closest star around which we have found a planet," says Geoff Marcy of San Francisco State University, who led the discovery team along with Paul Butler. Two planets have been previously reported orbiting the star Lalande 21185, only 8.3 light-years away, but most astronomers remain unconvinced these planets exist. All the other known planets orbiting other stars are at least 40 light-years away.

Gliese 876's planet goes around the star in an elongated path once every 61 days. It orbits its parent star five times closer than Earth orbits the sun, so it would be well inside Mercury if it were in our solar system. The planet has a mass of at least 1.9 Jupiters, meaning it is probably a giant ball of gas.

Besides being nearby, Gliese 876 is the lightest known star to have a planet. It is a red dwarf only one-third the mass of the sun. The eight solar-type stars previously discovered to possess planets are at least 85 percent the mass of the sun, so this discovery proves that very low-mass stars can have planets. Gliese 876's feeble energy output, only 2.5 percent that of the sun, probably isn't enough to sustain life on the planet or any moons it may possess.

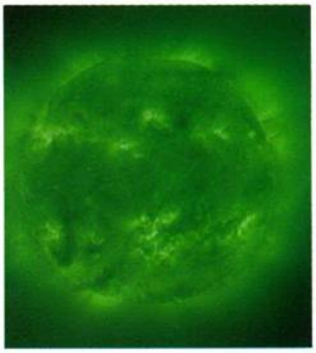
The other planet orbits the solar-type star Gliese 614, 60 light-years away. This planet has a mass of at least 3.3 Jupiters, meaning it is almost certainly a gas giant. It goes around the star in a near-circular orbit once every 4.4 years. The Gliese 614 planet is the farthest from its host star of all the planets discovered outside the solar system, orbiting at a distance of 2.5 Earth-sun distances (which would put it in the asteroid belt in our solar system). The planet has similar characteristics to the one orbiting the star 47 Ursae Majoris, which Marcy and Butler discovered in 1996.

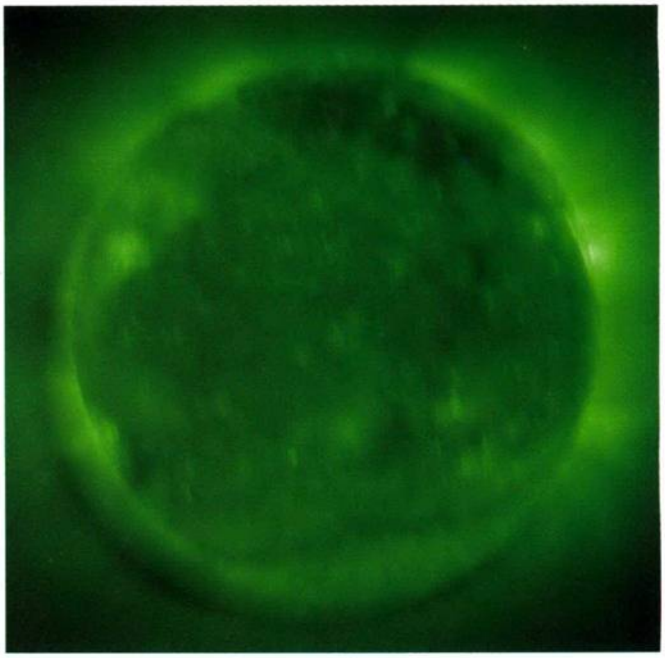
A team led by Michel Mayor and Didier Queloz of the Geneva Observatory in Switzerland discovered the Gliese 614 planet. Both planets were discovered indirectly by the wobbles their gravities induced on their parent stars.

SOHO

SOHO, Phone Home

Ground controllers lose contact with solar probe





The blurred image below was the last taken from SOHO before communications were lost on June 24; the one on the left was taken earlier in the day when things were still A-OK.

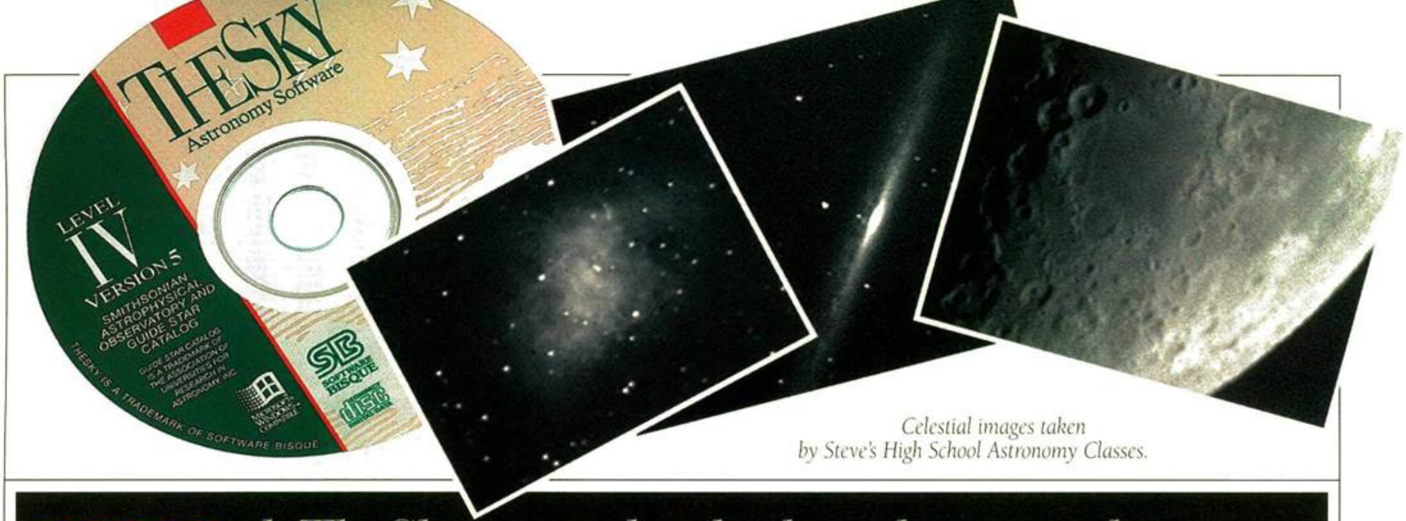
NASA/ESA/SOHO Consortium

▶ If a whirling windmill rotates 90° left or right from the direction of the wind, it will stop spinning. Likewise, on June 24, when the Solar and Heliospheric Observatory's (SOHO) photovoltaic panels apparently rotated 90° away from the sun, ground controllers lost radio contact with the spacecraft. Suddenly, the spectacularly successful SOHO was lost. Or was it?

NASA and the European Space Agency (ESA) scientists are not sure. They hope to reestablish control of the $1-billion satellite by September, when the revolution of SOHO around the sun by 90° is expected to align its photovoltaic panels directly at the sun.

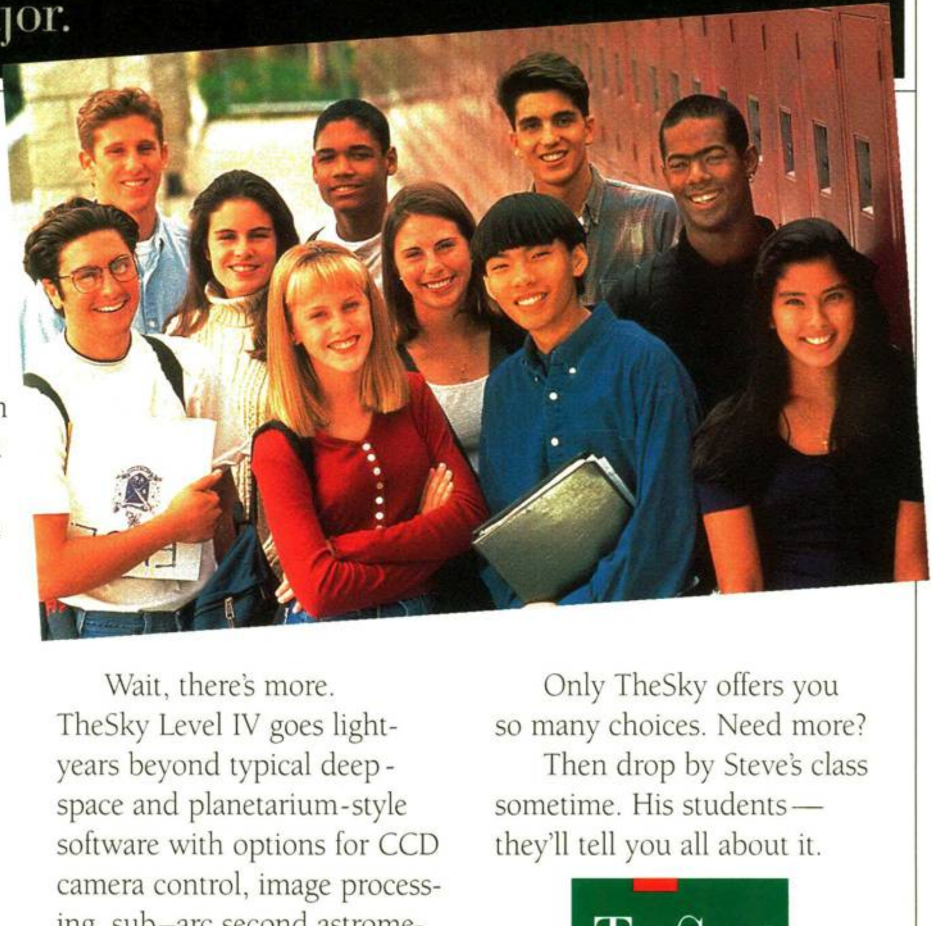
"It has become humanity's eye on the sun. To have that eye blanked out, at least temporarily, reminds us of its value," says Stanford University SOHO observer Craig DeForest. "It is almost certain there will be some damage because the spacecraft was never designed to be pointed away from the sun for any length of time,

(see "SOHO," p. 26)


TheSky
Astronomy Software
LEVEL IV
VERSION 5
SMITHSONIAN ASTROPHYSICAL OBSERVATORY AND GUIDE STAR CATALOG
THESKY IS A TRADEMARK OF SOFTWARE BISQUE
SB SOFTWARE BISQUE

Celestial images taken by Steve's High School Astronomy Classes.

With TheSky, an individual student can discover the stars, teachers can explore the heavens with their junior high class of thirty-five, or join 120 other schools and link up to Mt. Wilson and run rings around Ursa Major.



Ask teacher Steve Lantz. He chose TheSky™ Astronomy Software to engage, energize, and extend his students at Cherry Creek High School in Colorado.

Using TheSky, they link to Mount Wilson's 24-inch telescope and gather their own astronomical data to do real science. It's all part of creating a dynamic classroom learning experience.

Why TheSky?

For starters, TheSky Level II offers an incredible collection of celestial images and deep-space data including the gateway to the Digitized Sky Survey. All the things you expect are here — ease-of-use, star charts, telescope control, Guide Star Catalog, the Hipparcos and Tycho Catalogs, as well as comets and minor planets.

Wait, there's more. TheSky Level IV goes light-years beyond typical deep-space and planetarium-style software with options for CCD camera control, image processing, sub–arc second astrometry, telescope pointing and error correction, even preprogrammable scripting and remote Internet operation.

Only TheSky offers you so many choices. Need more?

Then drop by Steve's class sometime. His students — they'll tell you all about it.

TheSky™

Astronomy Software
1.800.843.7599

SB SOFTWARE BISQUE **www.bisque.com**

Software Bisque
912 Twelfth Street, Suite A
Golden, Colorado 80401
Fax: 303.278.0045 Phone: 303.278.4478

In a class by itself.

TheSky Level II at $129. TheSky Level IV starting at $249.

MARS PATHFINDER

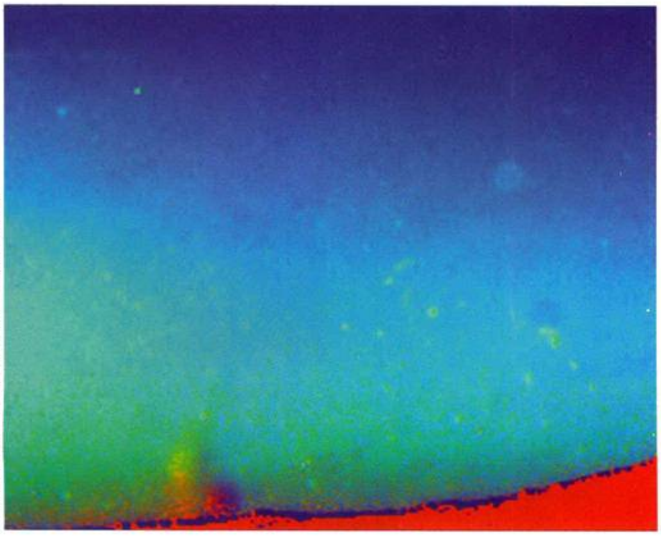
Martian Dust Devils Imaged

For folks living in desert regions, dust devils are a familiar part of the landscape. Newly-released Mars Pathfinder images show that future Mars astronauts will encounter them as well. "Dust devils are as common on Mars as they are in arid or semi-arid places on Earth," says Steve Metzger of the University of Nevada, whose computer processing of Pathfinder images allows the dust devils to be seen against the thick dusty haze of the martian sky.

Even before Pathfinder, scientists had spotted several giant martian dust devils in Viking orbiter images. In addition, Pathfinder's weather sensors recorded 20 atmospheric vortices similar to dust devils. But the sensors couldn't determine if the winds inside these vortices were fast enough to lift dust off the surface, meaning the vortices' role in the martian dust cycle remained uncertain.

The Pathfinder images reveal the small, garden variety dust devil compared to the rare behemoths captured in the Viking images. "What we're seeing is the daily business of dust getting into the atmosphere," says Metzger, who adds that dust devils can explain why Mars's atmosphere is so laden with dust. "Within a few hundred days all the dust would settle out of the atmosphere if it weren't for the fact that it's constantly being replenished. This is

(see "Dust Devils," p. 28)



This false-color Mars Pathfinder image shows a 50-foot-wide, 700-foot-tall dust devil winding down the slope of the southern Twin Peak (far right) at a speed of about one mile per hour.

Stephen Metzger (UNR), Jeffrey Johnson (USGS), et al.

(SOHO)
and some of the instruments have thermally sensitive components."

The malfunction occurred during a routine maintenance operation when thrusters moved the slightly errant satellite back to its optimal solar orbit. The critical problem occurred when ground controllers attempted to adjust the speeds of SOHO's reaction wheels, which are constantly spinning devices that help orient the spacecraft properly by speeding up or slowing down. Three times during the wheels' adjustments, the satellite sensed that it was turning away from the sun. SOHO automatically realigned itself by shifting into emergency sun reacquisition (ESR) mode. After the third ESR, the photovoltaic panels apparently rotated so far from the sun that the spacecraft lost power.

The asteroid Mathilde appears to be a loose pile of rubble that would be immune to even our most powerful nuclear weapons.

Johns Hopkins University

Astronomers have used SOHO's 12 instruments to take spectacular images, including many of coronal mass ejections that generate space weather (see "Blowin' in the Solar Wind," page 60). SOHO also helped scientists discover 50 sungrazing comets, rivers of plasma beneath the sun's surface, solar tornados and sunquakes, and a magnetic "carpet" on the solar surface that may explain how the sun's outer corona is heated from 6,000° C to more than one million degrees.

IMPACT HAZARD

Blasting Asteroids

It's tough to blow up space rocks

An asteroid hurtles through space on a collision with Earth. What would you do? Most people would exclaim, "Blow it up!" But Erik Asphaug of the University of California at Santa Cruz, and his colleagues, would shake their heads "no." Their recent study of mile-sized asteroids, published in the June 4 issue of *Nature*, shows that they aren't so easy to disrupt. "It's a lot more difficult to nudge these asteroids than we had thought," says Asphaug, who used computer simulations to study the effects of explosions on three different kinds of asteroids.

Earlier studies suggested that asteroids aren't solid bodies but rather loose clumps of debris held together by gravity. The new simulations show that if a large body impacts an asteroid, the damage remains localized. For example, imagine trying to break up an entire sand dune by smashing one end of it with a hammer. You'll create a nice crater, but the dune will barely move.

To complete the research, Asphaug and his colleagues began with a peanut-shaped asteroid with three different structures: solid rock, a pair

(see "Asteroids," p. 28)

Get closer to the stars atop Mauna Kea!

Imagine relaxing on a balmy island with the sweet smell of tropical flowers in the air, then traveling to the top of the world to stargaze and view the world's largest telescope. Now, turn this fantasy into reality by reserving your place on *Astronomy*'s

Hawaiian Skies Tour – February 12-20, 1999.

Begin this 8-day tour flying to the Big Island of Hawaii. You'll then accompany hosts Robert Naeye and Andrea Gianopoulos of *Astronomy* Magazine to the Mauna Kea Observatory, Punaluu Black Sand Beach Park, and travel to Oahu and the city of Honolulu.

THIS STARGAZING TRIP INCLUDES:

- Stargazing the breathtaking skies of the Southern Hemisphere at the world's premier observatory Mauna Kea.
- Touring the NASA facility to see the control room, dome, and the telescope. Then we proceed to the W.H. Keck Observatory.
- Visiting the amazing Volcano National Park.
- Experiencing all the beautiful sights and sounds unique to Oahu — Honolulu Zoo, Foster Botanic Gardens, the Iolani Palace, and so much more!

CALL NOW FOR MORE INFORMATION!

THIS TOUR WILL FILL UP FAST! CALL SPECIALTY TOURS AT (813) 796-7555

OR

1-800-677-9412

HURRY! LIMITED SPACE AVAILABLE!

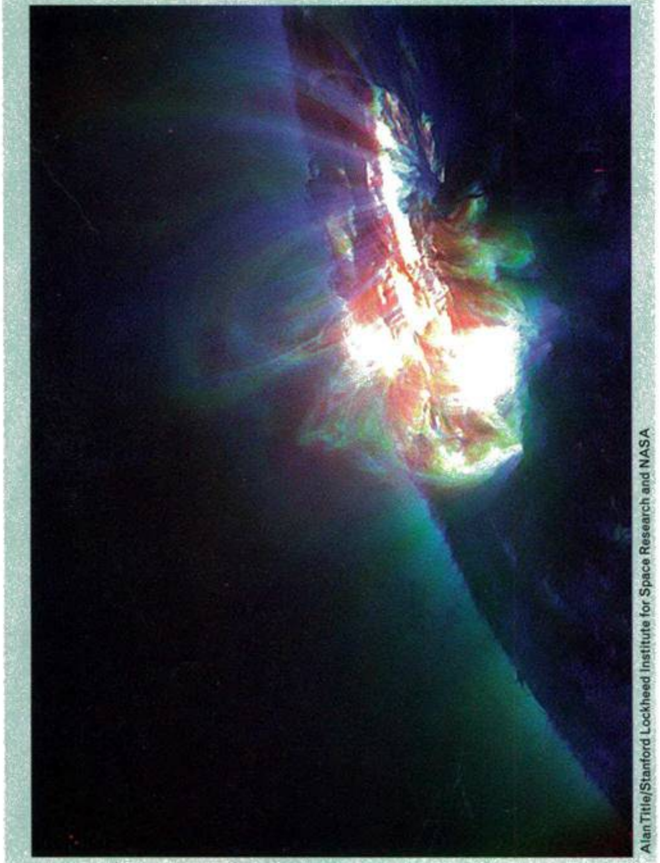
Astronomy®
MAGAZINE
WWW.ASTRONOMY.COM

(Dust Devils)

the only way to throw a significant amount of fine soil into the air all the time, all over the place."

While martian dust devils, like their terrestrial counterparts, are nowhere near powerful enough to pose a direct threat to humans, they will likely prove to be quite a nuisance to future Mars astronauts. "They'll lead to a generally dusty environment that's going to be a hassle for astronauts and their machinery," says Metzger. "The dust will be everywhere, on everything. It will be real tough to get away from it."

THE SUN



Alan Title/Stanford Lockheed Institute for Space Research and NASA

SOLAR LOOPS Launched on April 1, 1998, NASA's TRACE (Transition Region and Coronal Explorer) spacecraft shot this high-resolution ultraviolet image of an active region of the solar limb on April 25. The false-color image reveals detailed structure in loops of plasma (ionized hot gas) that are confined by powerful magnetic fields. The colors correspond to different plasma temperatures: blue is roughly 360,000° F, green is 900,000° F, and red is 2,700,000° F. Fifteen Earths could fit side by side within the larger loops.

(Asteroids)

of solid rocks, and a rubble pile. The team hurled house-sized rocks at each asteroid and measured the devastation.

Asteroids made from solid rock shatter into smaller pieces, but they don't always disperse. They may break into several large pieces or form a cluster of debris. Asteroids made from a pair of rocks seem to resist impacts because one of the rocks absorbs most of the shock from the impact. And rubble-pile asteroids seem even less affected.

Asphaug's work may explain observations of the asteroid Mathilde. Images from the Near Earth Asteroid Rendezvous spacecraft revealed old craters apparently unscathed by newer impacts nearby. Mathilde was also pocked by craters larger in diameter than the asteroid itself. If Mathilde is unaffected by such tremendous impacts, then a similar asteroid would probably shrug off any nuclear bomb we threw at it. "More work needs to be done before we can decide whether nuclear warheads provide a viable deterrent," says Asphaug.

JUPITER

White Ovals Come Together

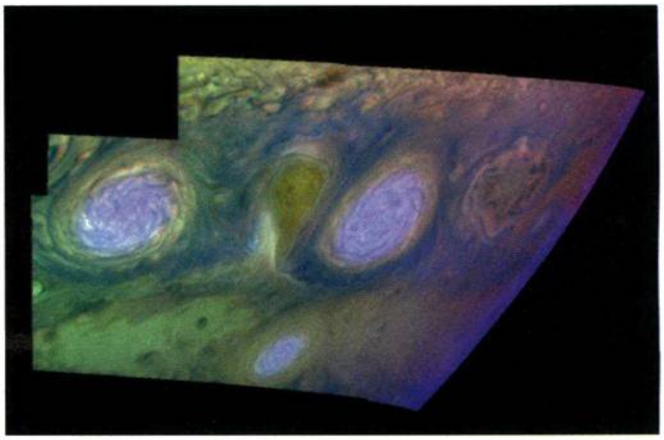
Two Earth-sized storms merge

▶ Yet another mega merger is making news, but this time it's not banks or broadcasting companies. After 58 years as separate entities, two Earth-sized cyclones in Jupiter's atmosphere have coalesced into one.

In June, several ground-based observers first reported the merger of two of the planet's three white ovals, storms second in size and splendor only to the Great Red Spot. Soon thereafter, the Hubble Space Telescope photographed a bigger white oval where one of the old ones should have been. Hubble images taken in mid-July showed that several cloud systems at the white ovals' latitude had dissipated or merged.

No one actually saw the merger, which took place in February when Jupiter was behind the sun. But in retrospect, astronomers had

The two Earth-sized white ovals seen in this Galileo image, named BC (right) and DE, apparently merged when Jupiter was behind the sun this past February. NASA/JPL



A TECH **A Video Tour of the Moon!**

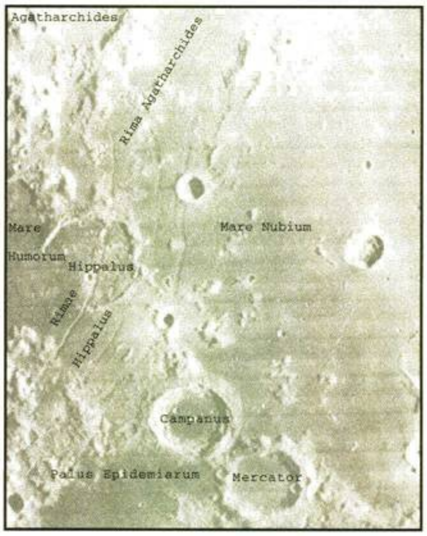
- Exciting New Educational Tool! There Is No Other Video Like This In The World! Let's Re-ignite The Adventure Of Space!
- See The Moon As It Would Be Viewed Through Any Moderately Sized Scope! Video Tour Is Narrated For Instruction!
- Dynamic Real Time Action Video Of Lunar Grazing Occultations and Eclipses!
- Labels Lunar Topography With I.A.U. Approved Names And Older Amateur Designations Where Needed!
- Also Includes Nasa Video From Ranger, Surveyor, Orbiter & Apollo Missions!
- Volume 1 Is Due For Release October 1st!
- Volume II, III & IV To Follow Soon! Each Video To Cover One Quarter Phase!

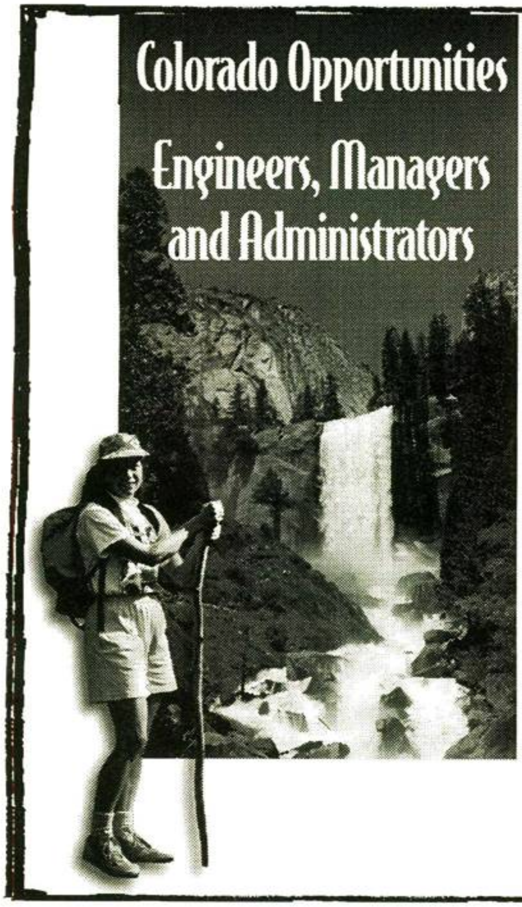
Send $99.95 Plus $3 S&H To:

A Tech
629 S.E. Quincy, Suite 204
Topeka, Kansas 66603-3927 USA
or Phone:

1-877-66A-Tech

1-877-662-8324 • Local 1-785-235-5252





In addition to exploring surrounding Boulder, Colorado on weekend hikes, rafting excursions and skiing trips...pioneers at Ball Aerospace & Technologies Corp. are busy unraveling the mysteries of the universe. Today we're designing and developing the most sophisticated technology on the planet in many of the nation's fastest growing high-tech markets. And we're looking for a few more bold, adventurous engineers ready to take the ultimate hike.

Principal Electro-Optical Engineer/IR Lab Manager
Analysis of IR detection systems and operation of IR lab.

Adaptive Optics Engineer
Adaptive optics systems design, test and application verification.

Electro-Optical Staff Consultant
conceptual design and analysis of CCD's and Imaging Optics

Digital Signal Processing Engineer
DSP Hardware/Software design and analysis

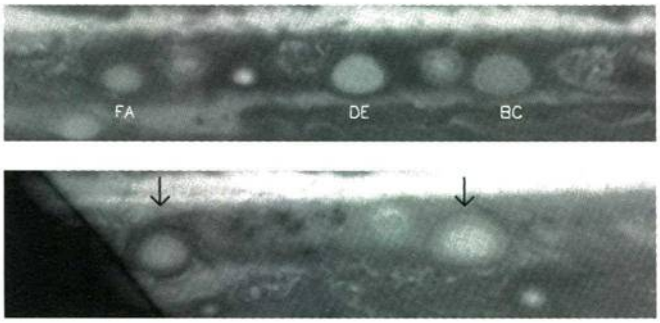
Digital/Signal Processing Engineer
Prototype signal/image processing, algorithm design, development and implementation

Senior Micro Integrated Circuit Technician
Requires strong experience in lithography and thin film processes. Wire bonding and micro circuit assembly desirable.

Ball Aerospace & Technologies Corp. offers a competitive salary and an outstanding benefits package. Please send your resume and salary history, in confidence, to: **Ball Aerospace & Technologies Corp., Human Resources Dept. 32-056, P.O. Box 1062, Boulder, CO 80306** or submit it electronically (with no attachments) by visiting our web site at http://www.ball.com/aerospace/jobhome.html. All resumes are optically scanned. To make your resume "scannable," please keep it clean and simple with clear, readable fonts. EOE M/F/D/V

Ball Aerospace & Technologies Corp.

www.ballaerospace.com



A Hubble Space Telescope image taken on October 21, 1996 (top), shows Jupiter's three white ovals. An image taken on June 4, 1998 (above), shows only two, strongly suggesting that DE and BC merged into one. Amy Simon, Reta Beebe (New Mexico State University) and NASA

seen hints. Caltech astronomer Ashwin Vasavada and his colleagues looked at the ovals in February 1997 with the Galileo spacecraft. "Two of the ovals were unusually close and another storm was squished between them," says Vasavada. "With 20/20 hindsight we could have said they were about to merge, but we had no idea at the time."

The white ovals are storms of ammonia moving nearly 200 miles per hour at their outside edges. They rotate like ball bearings between bands of clouds that, like Earth's jet stream, blow west to east around the planet. In 1938–39 a great white band in the southern hemisphere broke apart and coalesced into three gigantic white ovals. More than 9,000 miles across, they show up easily in a 6-inch telescope.

A collision of such large-scale storms was unheard of until now. "When the spots would get close to each other, one would bounce away," says Amy Simon of New Mexico State University, who monitors Jupiter with Hubble. But in 1995, the spots began piling up in a train. In November 1997, they were as close together as she'd ever seen. No one knows what drives these storms or why they last so long, but Simon and other astronomers hope that adding the oval merger to computer models of Jupiter's enigmatic atmosphere will help tell the story.

This frame — just 1/5,000 of a Sloan Digital Sky Survey first-light picture taken in May 1998 — shows Milky Way stars and distant galaxies in the constellation Serpens. Fermilab Visual Media Services

OBSERVING PROJECTS

Lights, Camera, Action!

First Light for Sloan Digital Sky Survey

▶ On May 9, astronomers kicked off the ambitious Sloan Digital Sky Survey at the Apache Point Observatory 2.5-meter telescope in New Mexico. Over the next five years, Sloan will systematically chart one-quarter of the entire sky to an unprecedented level of resolution, recording the colors, positions, and brightnesses of more than 100 million celestial objects. "It will give us a three-dimensional picture of the universe through a volume 100 times greater than anyone has explored before," says Bruce Margon of the University of Washington, the Sky Survey's scientific director.

The Sky Survey will measure redshifts of one million bright galaxies, providing accurate distance information that will help astronomers determine the extent to which galaxies cluster together. The Sky Survey will also record the distances to 100,000 quasars extending to near the edge of the observable universe. By recording quasars and galaxies at varying distances, the Sky Survey

This Sloan Digital Sky Survey image shows spiral galaxy NGC 6070 in Serpens, located more than 100 million light-years from Earth. Fermilab Visual Media Services

JMI ETX ACCESSORIES SHOWCASE

New **JMI** *Exclusive!!!*
Piggy-Back Camera Mount with Counterweight
$59.95 ($6)

Get fast Polar alignment
with
JMI's NEW ETX
"POLAR FINDER"
Sight tube
Easy to install
$49.95 ($5)

90° FINDER CONVERSION KIT
Converts Straight Through to 90°
$69.00 ($5)

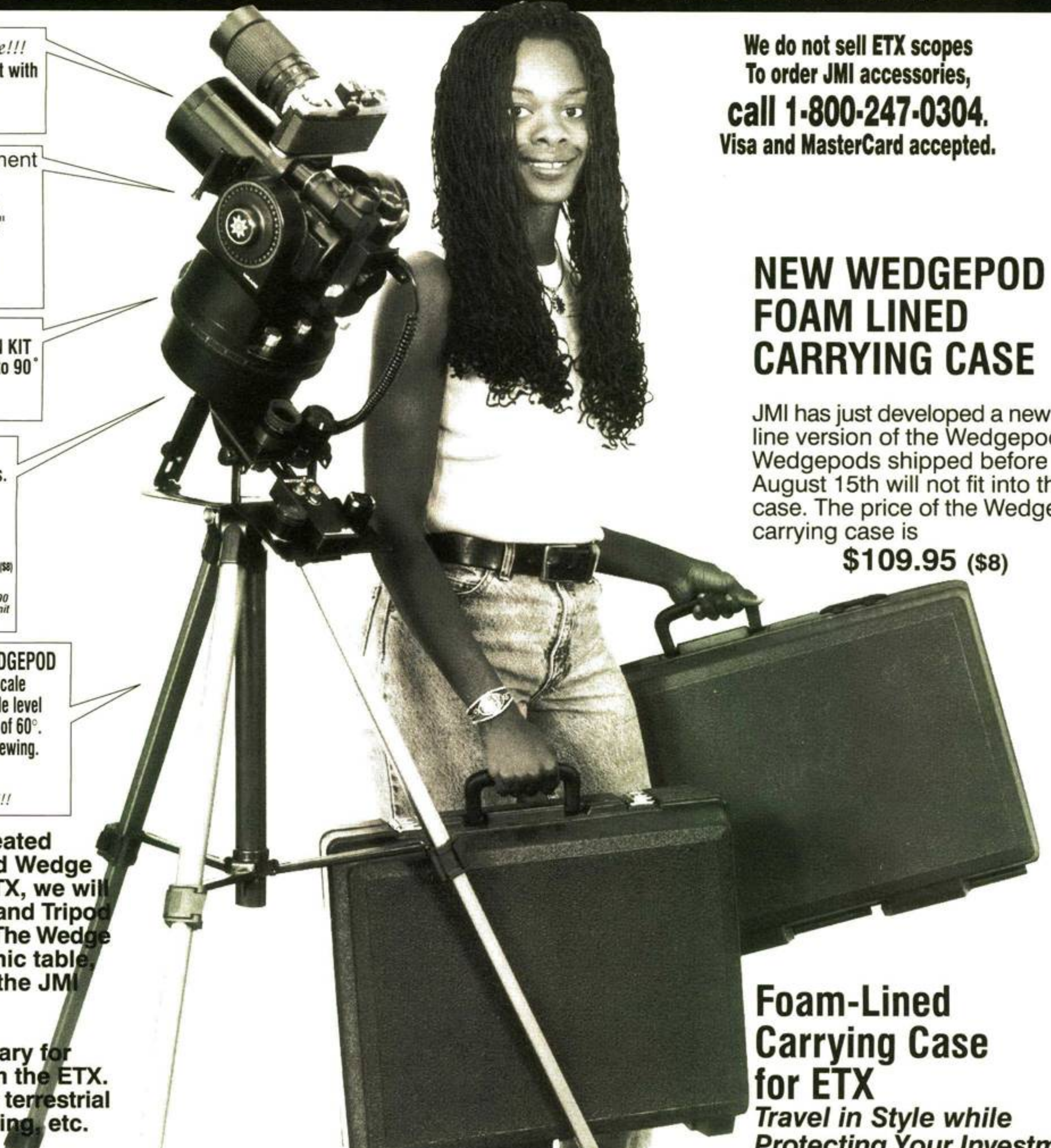
MOTOFOCUS
End the focusing wiggles.
$99.95 ($6)
New **JMI** *Exclusive!!!*

MOTOFOCUS & MOTODEC $169.90 ($8)

Order MOTOFOCUS & MOTODEC at the Same Time and Save Big - $169.90 ($8) - Includes One Dual Control Hand Unit (Reg. $10 Upgrade)

STURDY EQUATORIAL WEDGEPOD
Adjustable with latitude scale (20° to 60°). Includes bubble level
Adaptor available for North of 60°.
Also works for terrestrial viewing.
$199.00 ($8)
New **JMI** *Exclusive!!!*

We do not sell ETX scopes
To order JMI accessories,
call 1-800-247-0304.
Visa and MasterCard accepted.



NEW WEDGEPOD FOAM LINED CARRYING CASE

JMI has just developed a new thin-line version of the Wedgepod. Wedgepods shipped before August 15th will not fit into this case. The price of the Wedgepod carrying case is

$109.95 ($8)

Although we have created Wedgepod (combined Wedge and Tripod) for the ETX, we will still make the Wedge and Tripod available individually. The Wedge can be used on a picnic table, the Bogan Tripod, or the JMI Tripod.

The Wedge is necessary for tracking the stars with the ETX. The Tripod is great for terrestrial viewing or bird watching, etc. WEDGE $119.00 ($7)

Foam-Lined Carrying Case for ETX

Travel in Style while Protecting Your Investment.

- Professional Die-Cut Foam Lining -Top & Bottom (No cubes to fall out).
- Compartments to hold 5 to 6 eyepieces, barlows, hand controls, etc.
- Compartments to hold a MAX, mini-MAX, micro-MAX.
- Keys included to Secure ETX & Accessories.
- Will not hold JMI Field Tripod or Equatorial Wedge.

Get Organized for Only $109.95 ($7)

Shown with Declination encoder installed. All of JMI's computers fit the ETX.

MOTOFOCUS
JMI

Dual-Control Hand Unit shown for powering the MOTOFOCUS & MOTODEC

MOTODEC
JMI *Exclusive!!*
$99.95 ($6)
with Variable Speed Hand-Control

MOTODEC
Variable Speed for Slewing & Guiding in Declination.
Installs in Seconds. No Tools Required.

JMI FIELD TRIPOD

Sturdy, light-weight, compact. Can be used with equatorial wedge (required for tracking) or without.

$119.00
($7)

NEW!

FOR ETX ONLY

ETX Video Describing JMI Accessories $10 ppd.

Prices subject to change without notice.

Jim's Mobile Inc. • 810 Quail St. Unit E • Lakewood, CO 80215 Orders: 800-247-0304 • Info: 303-233-5353 • FAX: 303-233-5359

will help astronomers piece together the story of how galaxies evolve.

When completed, scientists all over the world will have access to the Sky Survey's enormous 12-terabyte database, which will rival the information content stored in the Library of Congress. More than 200 scientists and engineers from eight collaborating institutions in the U.S. and Japan are participating in the Sloan Digital Sky Survey.

BROWN DWARFS

A New Class of Star

Dim, cool gas balls are most common "stars" in galaxy

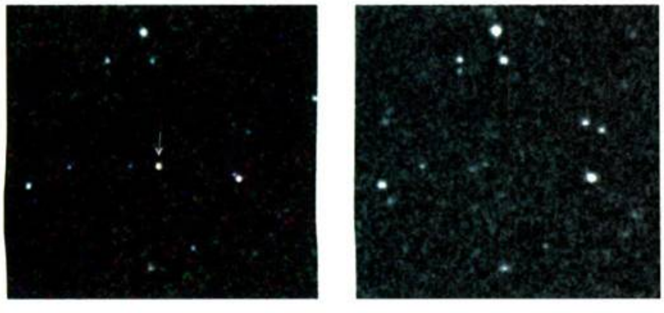
▶ Now that astronomers are imaging faint galaxies near the edge of the visible universe, you'd think they would have long ago identified the most common type of star in the Milky Way Galaxy. Think again. According to initial results from a deep infrared sky survey, which were presented at the June meeting of the American Astronomical Society in San Diego, astronomers are only beginning to find members of this population — very cool and dim balls of gas.

The infrared sky survey, known as 2MASS (for 2-Micron All-Sky Survey), turned up 20 of these objects after scanning just one percent of the sky. These objects have spectral features for all sorts of atoms and molecules that would burn up in normal stars. Most of them are probably brown dwarfs — "failed stars" that form in the same way stars do but that don't shine like stars because they aren't massive enough to sustain nuclear fusion (the primary energy source of stars like the sun) in their cores.

The spectra of these objects are so different from normal stars that Caltech astronomer J. Davy Kirkpatrick, a member of the 2MASS team, is leading the charge to update a century-old stellar classification system. From hottest to coolest, astronomers classify stars by the spectral types O, B, A, F, G, K, and M. To remember these letters, astronomers learn the mnemonic "Oh, be a fine girl (guy), kiss me." Kirkpatrick and other astronomers are tacking on

A 2MASS image taken in infrared light (left) reveals a brown dwarf 60 light-years away. The brown dwarf doesn't appear in a visible light image (right) because it is 1,000 times fainter in visible light.

Left image: J. Davy Kirkpatrick, Neill Reid (Caltech), et al. Right image: Palomar Digitized Sky Survey

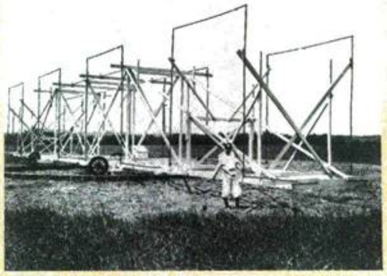


Japan Launches Mars Probe

On July 4, the Japanese Institute of Space and Astronomical Sciences successfully launched the half-ton Planet-B probe to Mars. Shortly after liftoff, the spacecraft was renamed Nozomi ("Hope"). The probe is scheduled to reach Mars orbit in October 1999, where, among other things, it will study the interaction of the solar wind with the Mars upper atmosphere and the rate at which oxygen escapes the atmosphere. Nozomi is the first interplanetary mission attempted by a nation other than the United States or the Soviet Union/Russia.

Radio Pioneer Gets His Due

The first person to record radio waves from space — Bell Labs scientist Karl Jansky — now has a monument commemorating his momentous discovery. In 1931, while searching for the sources of static in overseas radio signals, Jansky detected a steady hiss emanating from the direction of the galactic center. Jansky died in 1950, and his antenna vanished sometime during that decade. To erect the monument — a 13-foot-long stylized replica of Jansky's original 100-foot-long antenna — Nobel laureate Robert Wilson and Bell Labs astrophysicist Tony Tyson donned their detective's hats to pinpoint where the antenna had stood. Using Jansky's notebooks, old maps, and an aerial photograph, the two determined that the site of the antenna is now a grassy patch near a large parking lot. Says Tyson, "I was just relieved that the actual location was on grass and not asphalt."



Karl Jansky poses with the first radio telescope. Lucent Technologies

Comet Cash

Amateur astronomers all over the world can now add a cash prize to the glory of discovering a new comet. The Edgar Wilson Award, named for the late Kentucky businessman whose trust funds the prize, will be administered by the Smithsonian Astrophysical Observatory through the Central Bureau of Astronomical Telegrams (see "Policing the Universe," September 1998). Each discoverer whose name is officially assigned to a new comet will qualify for a portion of the $20,000 annual award. Comet counting has already begun for the first year's award, which will be announced next summer. If you think you've discovered a comet and would like to be considered for the prize, visit http://cfa-www.harvard.edu/iau/CometDiscovery.html.

Quality Imaging Affordable Price!

SBIG is proud to introduce the Model ST-5C second generation imaging camera as a high quality affordable CCD Camera for amateur astronomers. The ST-5C utilizes the Texas Instruments TC-255 CCD detector with 10 micron square pixels in a 320 x 240 array. It includes features found only in more expensive cameras such as 16 bit A/D resolution, regulated thermoelectric cooling, internal shutter for automatically taking dark frames, optional internal color filter wheel for automatic tri-color imaging, and the ability to operate as a highly sensitive computer controlled autoguider for astrophotography.

M51 Whirlpool Galaxy. *The first galaxy found to have spiral structure is about 35 million light years distant and about 10 arc minutes in apparent diameter. This five-minute ST-5C exposure was taken in moderate light pollution with a Celestron C8 reduced to f/4 using the ST-5C focal reducer. Courtesy Alan Holmes and Michael Barber / SBIG.*

New Windows 95 software includes SBIG's patented Track and Accumulate feature, tri-color merge functions, autoguide functions and many other features which were previously unavailable in a Single Windows software package. The ST-5C is PC and Mac compatible with high speed (<0.5 sec) screen updates for easy focusing. The small lightweight head is equipped with T-threads and a 1.25" removable nose piece for easy attachment to practically any telescope. An optional 35mm camera lens adaptor is also available. Everything you need to get started in CCD imaging is included in the introductory price of $895.

For catalog or demonstration disk contact:

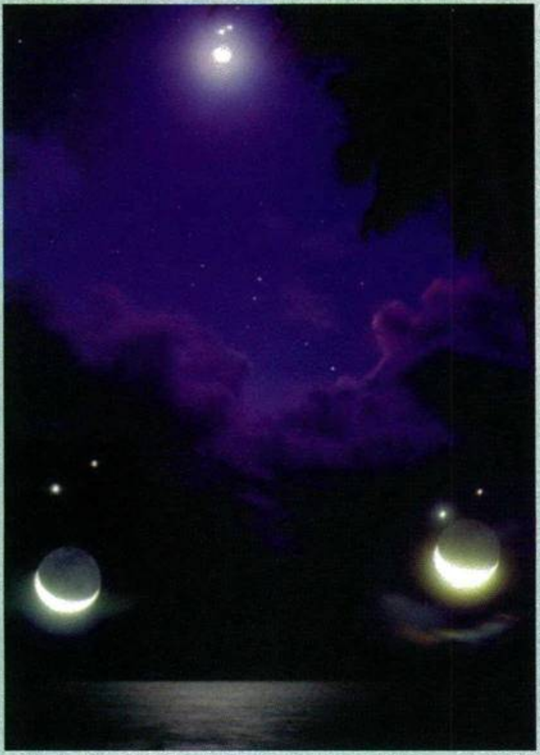
SBIG
ASTRONOMICAL
INSTRUMENTS

SANTA BARBARA INSTRUMENT GROUP
P.O. Box 50437
Santa Barbara, California 93150
Phone (805)969-1851 FAX(805)969-4069
e-mail: sbig@sbig.com home address:www.sbig.com

the letter L to the end of the sequence to represent these new objects, changing the mnemonic to: "Oh, be a fine girl (guy), kiss my lips."

Astronomers have more to mull over than just a new ditty. "Based on the 2MASS results so far, we think these L dwarfs are the most common spectral type in the galaxy," says Kirkpatrick. "They are so commonplace that there is a very good chance that we will discover one that lies closer to the sun than Proxima Centauri, the closest of the known stars."

OCCULTATIONS



Erich Karkoschka (University of Arizona)

ONCE-IN-A-MILLENNIUM On April 23, 1998, University of Arizona astronomer Erich Karkoschka and four Brazilian amateur astronomers photographed a rare event that hasn't occurred for more than 1,000 years: the moon simultaneously occulting Venus and Jupiter. The photo was taken near the easternmost point on the Brazilian coast, about 60 miles north of Recife. "This event was visible in the night sky of the southern Atlantic Ocean, including a few islands and a small part of Brazil," says Karkoschka.

Karkoschka's image shows an overexposed moon with the two planets (top). The inset at lower left is a view taken at about the same time with a telephoto lens. The other inset was taken an hour earlier when the two planets emerged behind the limb of the moon.

The last such occultation occurred on August 18, A.D. 567, but was only visible from a small part of the Indian Ocean. "It is not known if anybody observed the 567 occultation," says Karkoschka. "Given the rarity of such an event and the small zone of visibility, there may be no record that such an event has ever been observed before in the history of mankind."

PLANETARY NEBULAE

Rosetta Stone

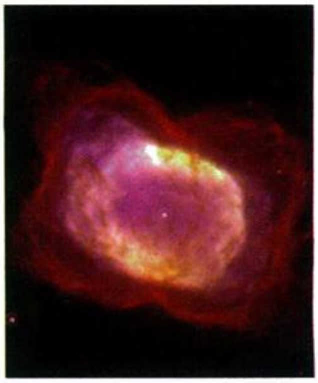
▶ The Hubble Space Telescope's NICMOS infrared camera has caught a young planetary nebula in a brief transition phase, which will help astronomers better understand the formation and evolution of these gaseous death shrouds of solar-type stars.

The NICMOS image (top) clearly shows a cloud of gas and dust (the bright whitish material) surrounding NGC 7027, 3,000 light-years away in Cygnus. This cloud was thrown off by the dying star when it was a red giant. A nasty dose of ultraviolet radiation from the hot, dying star is heating and ionizing the material, causing it to glow brightly in infrared light. The cloud will be destroyed in perhaps as little as a thousand years — a blink-of-an-eye on a cosmic timescale.

In addition, Hubble has resolved a wavy transition region (the thin, red, filamentary material) between this hot cloud and an outer envelope of cooler gas. This gas — mostly molecular hydrogen — is being heated and split into hydrogen atoms by the star's ultraviolet light.

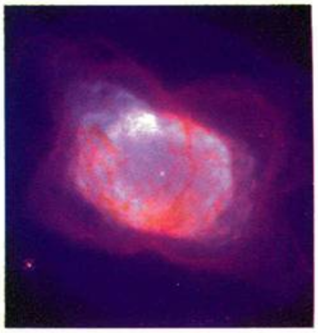
The Hubble image shows that the transition region is beginning to assume a bipolar (hourglass) shape typical of many older planetary nebulae. This is difficult to visualize because we are only seeing two dimensions and the axis of the hourglass is tilted to our line of sight. If we could see this transition region in three dimensions, we would see two cones with their ends pointed together and opening outward.

"What causes the bipolar shape is still a mystery, though there are a number of theories," says William Latter of the SIRTF Science Center and Caltech. "We can see with NGC 7027 that the shaping must take place very early in the life of a planetary nebula. The full importance of these data cannot be known now. It will take much thought and new theories to give us the knowledge we seek."



Hubble captures NGC 7027 in infrared light (above) and in a combination of visible and infrared light (below).

William Latter (SIRTF Science Center/Caltech), et al., and NASA



WEBSITE

Check out *Astronomy's* website for news as it happens – http://www.astronomy.com

Samy's Camera

200 South LaBrea Avenue
Los Angeles, CA 90036
800-321-4726
323-938-2420 • Fax: 323-937-2919

Visit Samy's Website: www.samys.com • E-mail Address: info@samys.com

CELESTRON®

20x80 GIANT DELUXE #71015
BINOCULARS Now In Stock!
Samy's Price: $419.00

ONE LEFT IN STOCK!
New Celestron C5 Telescope
with Case $799.00

Samy's Camera Stocks the Complete Star Hopper Line! Prices from $209!

Star Hopper 4½	$209
Star Hopper 6	$399
Star Hopper 8	$499
Star Hopper 11	$849
Star Hopper 14	$1099
Star Hopper 17½	$1999

Celestar 8 #11015
Samy's Price
$1079.00

Firstscope 114 Premium
$319.00

Get Your Firstscope at Samy's Camera

Firstscope 60	$99
Firstscope 60 Deluxe Aluminum	$139
Firstscope 60 EQ Deluxe	$169
Firstscope 70 EQ	$239
Firstscope 80 EQ	$329

PENTAX® **EYEPIECES IN STOCK! 5.2mm, 7mm, 10.5mm, 14mm, 21mm, 28mm, 40mm**

CAMERAS • FILM • LIGHTING • RENTALS • DIGITAL IMAGING • VIDEO

At Roger W. Tuthill, Inc., We Don't Just RESHIP Meade and Celestron Scopes as Others Do, We Test Them Individually.

Our Experience of 25 Years Lets Us Apply a "Personal Touch", Inspecting & Improving the Telescopes We Sell. Our Line of Accessories Makes Them Easier to Use and Gives You Less Hassle. Why Gamble With a Big Volume, Impersonal, Quick-Sale-Mail-Order Company? For Answers or Advice, Call TOLL FREE 1-800-223-1063 and Talk to **Astronomers, NOT Clerks.**

WE OFFER "TWO-TIER PRICING" – A PROVEN CONCEPT

Send a 9" x 12" S.A.S.E. with 4 stamps for complete catalog. Includes prices and description of **DELUXE CERTIFIED SCOPE PACKAGES** for Meade 7", 8", 10", LX10 , LX50 & LX200, as well as 12" LX200, and Celestron C5+, Celestar 8", Ultima 9¼", and Ultima 11".

All DELUXE CERTIFIED MEADE and CELESTRON S.C.T.s come with:

- **Tuthill Inspection, Guarantee and After-Purchase Support**
- **Free set of Tuthill Astro-video Instruction tapes.**
- **25% off Tuthill accessories when purchased with scope.**

Visit our showroom. We carry binoculars, Lumicon filters, JMI products, Tele Vue refractors, astronomy books, software, and ALL brands of accessories.

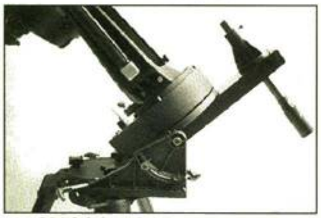
We clean and repair Meade & Celestron SCT's.

Tuthill Accessories

Meade 8" LX50 or Celestron Ultima 9¼" on Isostatic Equatorial Mount

Heatable NO DU CAPS for SCTs and Refractors

80mm Erect Image ULTIMATE FINDER includes bracket and 21mm ocular.


PRECISION POLAR AXIS FINDER® for EXACT polar alignment in minutes.

Roger W. Tuthill, Inc.
11 Tanglewood Lane, Dept. A • Mountainside, NJ 07092 • Phone 908-232-1786 • FAX 908-232-3804
VISA, MC, COD, Personal Checks, Time Payment Plans

Camera Corner

Largest Selection of Telescopes in North Carolina

• Telescopes • Spotting Scopes • Binoculars
• Tripods • Eye Pieces • Accessories • Cases • Books
• Maps • Globes • Cameras • Film • Processing

Meade ETX

All Name Brands Available
• Bushnell • Celestron • JMI • Lieca • Meade
• Nikon • Pentax • Tele Vue

Camera Corner
2273 South Church St. • Burlington, NC 27215
Fax # 336-222-8011 • 336-228-0251
e-mail: sky@camcor.com • www.camcor.com

800-868-2462

IDENTI-VIEW™

PREMIUM GLASS SOLAR FILTERS

- SAFE • HIGH QUALITY
- STRICT CONTROL STANDARDS
- LIMITED LIFETIME WARRANTY

CLASS "A"
Color band - blue. Class "A" filters are made with the same premium quality polished glass and multi-alloy coating as Class "B". An additional steel alloy added to the coating process makes our Class "A" filters extremely scratch and fade resistant. Excellent for visual and photographic use. Light transmission is 1/1000th of 1%.

CLASS "B"
Color band - white. Class "B" filters are made with polished glass and multi-alloy coating. These filters offer great durability and will provide many years of service and enjoyment with normal use. Can be used visually and for photography. Light transmission is 1/1000th of 1%

CLASS "C"
Color band - red. Class "C: filters are specifically coated to a lighter density (ND-4). They are for photographic use only. This filter is intended for use by professionals and serious hobbyists. Light transmission is 1/100th of 1%.

ORDERING INFORMATION

1. State scope brand and model number, aperture and outside diameter with filter class and price.
2. Make check or money order payable to J.M.B. Inc. All foreign checks must be payable through a U.S. bank.
3. Shipped free within th continental United States. All others add $5.50 Shipping and Handling per filter. Michigan resident add 6% sales tax, allow 2-3 weeks for delivery.

Now taking orders for the February 1998 Eclipse.

VISA **J.M.B. INC.** MasterCard
20762 Richard • Trenton, MI 48183
(734) 675-3490 • FAX (734) 692-5772
"Imitated but never duplicated"

OPT "YOUR ONE STOP Optics Shop"

Meade® Experts

Meade® CCD Cameras

"Quality, selection and priced to sell"

TALK TO FACTORY-TRAINED EXPERTS

We have the most knowledgeable, friendly, bend-over-backwards, knock-themselves out-for-you staff anywhere in the universe.

1-800-338-9638

Huge selection on display!

ETX Astro

"Hottest scope ever"
-Sky & Telescope

In stock

LX200

World's best-selling serious telescopes
8" and 10" LX200's in stock

We're not just a phone number—we're a real store!

Experience our online catalog at www.optcorp.com

JMI • Kendrick • Losmandy
Lumicon • Optec • Orion
1000 Oaks • SBIG
Yadda Yadda Yadda

CELESTRON®

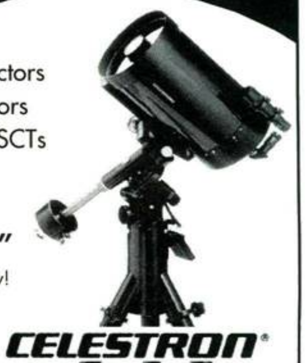
"Binoculars for every occasion"

Tele Vue

"TOPS IN THE FIELD"

Tele Vue specialists here to help you.

- Reflectors
- Refractors
- DOBS • SCTs



The NEW CM1100 11"
Available Now!

CELESTRON®

OCEANSIDE PHOTO & TELESCOPE
1024 MISSION AVE
OCEANSIDE CA 92054
OPEN 7 DAYS
email: opt@optcorp.com

1-800-338-9638

HOME-DOME® & PRO-DOME™

HD-10 Hanover, PA

- True Rotating Dome
- 6, 10, 15ft. Diameter
- Wide Slot Openings
- Easy Assembly
- All Fiberglass
- Complete Systems Priced from $1950

Also, dome automation systems for remote observing. Call for more information

Technical Innovations, Inc.
22500 Old Hundred Rd.
Barnesville, MD 20838
Ph: 301-972-8040
Fax: 301-349-2441
www.homedome.com

FREE Brochure

SkyView™ Deluxe
NEW! EQ Series NEW!

Improved Features, Enhanced Performance, Unrivalled Value.

Look What's Included!

- New heavy-duty SkyView Deluxe equatorial mount
- Built-in reticle bore scope for quick, easy polar-alignment
- Achromatic 6x30 finder scope
- Two Plössl eyepieces (1.25")
- Moon filter
- Rigid gold-anodized aluminum tripod with accessory tray
- FREE *Where the Stars Are* CD-ROM (Windows)

SkyView Deluxe 6" EQ Newtonian

Features a diffraction-limited 6" *parabolic* primary mirror — not a cheaper, lesser-performing spherical mirror like on many competing (and more expensive!) 6" Newtonians. The difference in image quality is obvious! Focal length 750mm (f/5). #9403

SkyView Deluxe 4.5" EQ Newtonian

An exquisite combination of form, function, and affordability for the intrepid stargazer. Focal length 900mm (f/7.9). #9402

SkyView Deluxe 90mm EQ Refractor

Exceptionally crisp, high-power views of the Moon, planets, and beyond! Multi-coated 90mm (3.5") glass achromatic objective lens. Focal length 1000mm (f/11.1). #9401

ORION
ORION
ORION

6"
$599
($49 S&H)

4.5"
$459
($39 S&H)

90mm
$549
($39 S&H)

Compare our prices to other brands!

Add an AccuTrack™ DC Motor Drive
#7825 **$99**

Our 23RD Year!

Available from finer optical instrument retailers. Or, order direct from Orion.

To Order, Call
800-447-1001

ORION
TELESCOPES & BINOCULARS

Visit us on the Web! **www.oriontel.com**
P.O. Box 1815-A, Santa Cruz, CA 95061
Call Toll Free (800) 447-1001 for a free catalog.

Pocono Mountain Optics

• 2 GREAT LOCATIONS TO SERVE YOU • CALL OR WRITE FOR OUR FREE CATALOG

POCONO POCONO

SOLAR VIEW™ SOLAR FILTERS *by THOUSAND OAKS OPTICAL*

Manufactured exclusively for Pocono Mountain Optics by Thousand Oaks Optical

- **Highest quality**
- **Sizes to fit all telescopes and binoculars**
- **17 years of quality manufacturing in solar filters**
- **Most popular sizes in stock for immediate delivery**
- **30 day unconditional money-back guarantee**
- **10 free solar eclipse viewers with purchase of any filter ($10 value)**

Revolutionary New Coating & Deposition Process

Type A — Made with high quality hand-select glass and TRIPLE COATED with nickel, chrome and stainless steel. Originally developed by Thousand Oaks Optical in 1983. The most durable solar filter on the market for thirteen years. Second only to the new Type A Plus. These filters are available at reduced prices while supplies last. Guaranteed six years.

Type A Plus — Made with high quality hand-select glass and coated with Thousand Oaks Optical's exclusive Solar II Plus. Dramatically more resistant to wear due to excessive handling and fading that results from long-term exposure to ultraviolet radiation. Durability of these new filters is unmatched. Guaranteed 15 years.

Type A and Type A Plus are for unlimited visual use and general photographic use. Solar image is yellow-orange.

Type C PLUS — Lighter density (ND-4) for maintaining fast shutter speeds when using "slow" fine grain films. For photographic use only.

APERTURE	TYPE A	TYPE A + or C +
2.4"	38.00	52.00
3.1"	42.00	55.00
3.5"-4.5"	49.00	65.00
5.0"	62.00	85.00
6.0"-7.0"	67.00	92.00
8.0"-10.0"	92.00	112.00
11"	99.00	139.00
12"-13.1"	119.00	159.00
14"	139.00	179.00
BINOCULARS	**TYPE A**	**TYPE A +**
40-80MM	79.00 pr	99.00 pr

NEW NEBULA FILTERS
Type LP-1 Broad Band, Type LP-3 Oxygen, Type LP-2 Narrow Band, Type LP-4 Hydrogen. Available for 1.25"& 2" eyepieces. From $89.00

CELESTRON

We carry the full line of Celestron Telescopes and Accessories

All New Celestron® Star Hopper® Dobs Now Available in the following sizes: 4½" f/8, 6" f/8, 8" f/6, 11" f4.5, 14" f4.5, 17½" f4.1

Most Celestron scopes in stock for immediate shipment. Binocular Special Sale now in progress.

SKY/mount
by VIRGO.

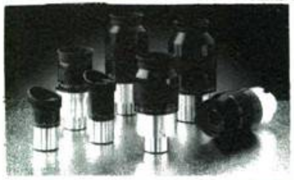
$174.95
plus shipping & handling
(Tripod optional)

- **All Aluminum, elegantly machined construction -steel weights**
- **Baked on, black ceramic finish- scratch resistant**
- **Popular "flexible parallelogram" holds aim at any height**
- **Easy set up on any heavy-duty tripod**
- **Secure, stable and easy to use for almost any size binoculars**
- **Tight-grip knobs reduce position slippage**

Tele Vue "WHEN YOU WANT THE FINEST"

We stock the entire Tele Vue line for immediate shipment. All items also on display and available for purchase and pick up at both of our showrooms.

NEW for 1998! Introducing the exciting new "TV-85". 85MM, 600FL, F-7 APO Refractor recently seen and demonstrated for the first time during Tele Vue Day at Pocono Mountain Optics. Call today for exciting details and availability.



Imagine a Walk in Space!

NAGLERS 82° Apparent Field of View

Patented Tele Vue Naglers offer the widest, sharpest views available. Why settle for a back seat view when you can experience a *spacewalk*?

Choose from 4.8, 7, 9, 12, 13, 16 and the amazing 20mm! Call us today for sharp prices and large selection!

Tack Sharp!

PANOPTICS 68° Apparent Field of View

Attack your sharpness problems with Tele Vue's newest eyepiece — the Panoptics. The 2" 35mm and 27mm are considered to be the sharpest in their focal length class. The 1¼" 22mm, 19mm and 15mm offer outstanding performance, lighter weight, smaller size and lower cost when compared with similar focal length Naglers.

Tele Vue's Best Eyepiece Value!

PLOSSLS 50° Apparent Field of View

Patented Tele Vue Plossl eyepieces started the trend toward higher-quality, high-performance eyepiece designs. And today, despite the many imitators available, they still deliver the sharpest views in their class. And buying Tele Vue Plossls is the smart way to stretch your astro dollar. Our stock selection includes 1¼", 8, 11, 15, 20, 25, 32, 40fl. Don't forget the 2" 55MM, which yields the widest true FOV available. NEW 8MM-24MM 1.25" ZOOM Eyepiece.

PRONTO
70MM AP.6.8, 480MM F.L. Available in 1 1/4" Image Erect, 1 1/4" Star Diagonal and 2" Star Diagonal models. "The little Scope - that could"

MONTHLY SPECIAL
PRONTO w/2" DIAGONAL
Panoramic Mount and Quick Point Finder CALL

New 5x Powermate now in stock

Purchase a TV-101 and get a FREE Plossl eyepiece.

TELRAD w/Base
$39.00
Batteries included!

Hinged Deluxe Dew Caps	$10.00
Extra Bases	$ 7.95
Extra Reticles	$ 2.95
Pulsar Unit	$19.95

— DON'T BE LOST IN SPACE —
Navigate through the heavens with ease this year with our Exclusive Package
• Telrad w/Base • Planisphere
• Set of Messier Finder Books for Telrad
ALL FOR ONLY $68.00 plus shipping

The Kendrick Dew Remover System for all size scopes, finders and mirrors

Dew Controller (Works up to 4 Heaters)	**$64.00**
120 Volt Conversion Kit	**$59.00**
.965"/1.25" Eyepiece Dew Heater	**$30.00**
1.25"/2" Eyepiece Dew Heater	**$33.00**
2" Dew Heater	**$34.00**
3" Dew Heater	**$38.00**
4" Dew Heater	**$41.00**
5" Dew Heater	**$44.00**
5.5"/6.5" Dew Heater	**$45.00**
7"/8" Dew Heater	**$49.00**
9"/10" Dew Heater	**$59.00**
11" Dew Heater	**$63.00**
12" Dew Heater	**$68.00**
14"/16" Dew Heater	**$77.00**
Telrad Heater	**$19.00**
1.83"/2.14" Secondary Heater	**$22.00**
2.60"/3.50" Secondary Heater	**$24.00**
4.00" and up Secondary Heater	**$25.00**

Flexible Dew Caps from Kendrick
ETX 90mm - $25
5" - $31
6" - $41
7/8" - $49
9.25" - $52
10" - $59
11" - $68
12" - $83
14" - $99

New Products Exclusively from Kendrick

Heater Unit for LX-200 Command Hand Control	$33
Heater Unit for Your Lap Top Computer	$119.00

PORTA PAC
Heavy Duty
12 AMP HR.
$86.95
Porta Pac 5 AMP HR...... $75.00
New 17 Amp hr. $119.00

ETX Accessories

Right Angle Finder Conversion	**$49.95**
ETX for 1.25"	**$29.95**
ETX Mini Tele-Extender	**$29.95**
LAR Adapter (for SCT Accy,s)	**$29.95**

ETX OWNERS!

New Apogee Wide Field Adapter. This adapter brings the ETX f.l. down to 750 mm and f-ratio to f8.28! Magnification with the 26mm Super Plossl which comes with the ETX goes from 48x down to 29x. Field of view increases from 1.1° to 1.8°.

Requires Apogee's ETX to 1.25" Adapter (See ETX Accessories).
Introductory Price $89.95

Desert Storm Covers
Protect your investment — Covers available for all size scopes

Manufactured with a thick mylar "heat resistant" material

4"-6" Dobs & SCTs	$21.95
7"-8" Dobs & SCTs	$26.95
10"-13" Dobs & SCTs	$32.95
14" SCTs	$38.95
16"-18" Dobs	$44.95
20"-25" Dobs	$54.95

Dealer Inquiries Invited

Pocono Mountain Optics

POCONO MOUNTAIN OPTICS

104 NP 502 Plaza, Moscow, PA 18444
Fax: 717-842-8364 E-mail us at pocmtnop@ptdprolog.net

ORDER HOURS: 9-9 Mon.-Fri., 9-5 Sat., 12-5 Sun.
SHOWROOM HOURS: 10-5 Mon.-Sat., 12-5 Sun.

MOUNTAIN OPTICS
WEST OPTICS

ORDERS: 800-569-4323
INFO: 717-842-1500
ORDERS: 800-635-3607
INFO: 702-252-7200

YOUR AUTHORIZED MEADE ADVANCED PRODUCTS MAIL ORDER DEALER

Meade Dobsonians: Available in: 6"F/8, 8"F/6,10" F/4.5, 12.5" F/4.8, 16" F/4.5, optional deluxe accessory package $49.95

Meade Model 395-90MM, F-11 Refractor on Equatorial Mount. 1.25" Rack and Pinion Focuser, Manual Slo-Motion controls, 6x30 Finder Scope. $599.

Meade LX-200 SCT's, The World Famous "GoTo" Telescope Available in 8" F/10 or F/6.3, 10" F/10 or F/6.3, 12" F/10, 16" F/10.

Meade Equatorial Starfinders, Available in: 6"F/8, 8"F/6, 10"F/4.5, 16"F-4.5. Complete with DC, RA Motor Drive, 2"Focuser and Finder.

Meade ETX 90MM Maksutov Telescope, goes with you at a moment's notice. Includes Maksutov-Cassegrain optical tube assembly w/EMC Super Multi-Coatings, built in DC drive, 26MM Super Plossl, fork mount and tabletop tripod. IN STOCK for immediate delivery. $595. ETX Spotting Scope $479.

Meade Model 4500-Ideal for the Beginning Amateur: 4 1/2" Reflector on Equatorial Mount, Manual Slo-Motion Controls, 6x30 Finder Scope $399.00 531 DC RA Motor Drive Available.

Meade day at Pocono West Sept.12. Visit our showroom, meet Meade reps and see the latest products.

ACCESSORIES FOR ETX

#126 Barlow	$47.95
#64 T-Adapter	Call
#932 Image Erect Diagonal	Call
Carrying Case	Call
Meade 8" LX-10	**$995.**
Super Wedge	$395.
New Field Derotator for 8", 10",and 12" SCT's, and 7" Maksutov	$395.
Magellan I	
#2010 for all Meade Dobsonians	$295.
#2011 for DC Starfinders-6"-8"-10"	$295.
#2014 for LX-10	$375.
Magellan II	
#2018 for DC Equatorial Starfinders-6"8"10"	$495.
#2024 for LX-50	$495.
Pictor Series CCD's	
201XT	$395.
208XT	$495.
216XT	$695.
416XT	$1,695.
616 color wheel (for 416XT & 616XTI	$695.
616A color wheel (for 216XT)	Call
3000 Series Plossls 5,6,7,9.5,16,25MM	$49.95
3000 Series Plossls 40MM	$79.95

World Renown Series 4000™ Eyepieces

New 7.7-23.1MM Zoom eyepiece in stock.

Complete line in stock for immediate delivery!

POCONO MOUNTAIN OPTICS is pleased to offer the following products to better serve you —

- S.B.I.G. CCD Cameras
- *Rainbow Optics Star Spectroscope*
- *Apogee Cameras*
- *Optec Focal Reducers*
- *Homeyer Flip Mirrors*
- *Pentax Eyepieces*
- *Takahasi Telescopes & Accessories*
- *Parallax Mounts & Accessories*
- *Brandon/Questar eyepieces*

INTRODUCING!

Apogee's New 4" F/6.4 "Widestar" Richfield Refractor. Complete with 2" Focuser, 2-1.25" Adapter, 1.25" Star Diagonal and 25MM Plossl. Introductory Price: $795.00

BINOCULAR SPECIALS

Fujinon
FMT SERIES
Ideal for Astronomy

Contact us for the best pricing on the best binoculars for Astronomy —
6x30 FMTR-SX, 7X50 FMT-SX, 7X50 FMTRSX, 7X50 FMTRCSX The unbelievable 10X70 FMT-SX and the 16X70FMT SX.
7x50 and 10X70 have eye relief of 23MM
16X70 has eye relief of 12.4MM

Tripod Adapter Bracket..........$18.00

Available for immediate shipment
We also carry and stock Zeiss, Swarovski, Swift, Nikon, Pentax, B&L, Steiner, Minolta and Kowa spotting scopes.

JIM'S MOBILE

We stock the entire JMI line -
SPECIALS

MotoFocus for LX5/6/200	$95.00
MotoDecs — for all Meade SCTs	$85.00
C-8 Moto Dec	$77.00

SCT Owners; avoid image shift —
NGF-S Focuser w/MotoFocus..........$249.00

Wheeley Bars for all Scopes:

For Meade/Celestron SCT's w/Levelers	$145.00
Also Available for Meade 12"/Celestron 11"	CALL

NEW ACCESSORIES FOR ETX:

Wedge w/Levelers	$115.00
Tripod	$119.00
MotoFocus/MotoDec Combo w/hand control	$165.00
New Piggyback Bracket for ETX	$48.00
New Hard Case for ETX	$119.00

RIGEL SYSTEMS

Starlite Dual LED Flashlight	$22.00
NEW Skylite: Dual Color LED Flashlight	$29.95
Quick Finder	$35.00

FINDER SCOPES

7x50 Straight Through Finder	$49.95
12x60 Straight Through Finder	$99.95
7x50 Right Angle Finder	$99.95
12x60 Right Angle Finder	$119.95

BEATTIE INTENSCREEN-PLUS

Ultra bright focus screens for:

Olympus OM - 1, 2, 3, 4	$62.00
Nikon F, F2, F3	$93.95
Nikon FE, FE2, FM2, FA	$62.00

LOSMANDY GM8 Mount

Complete System Package

Dual Axis, PEC DRIVE, North-South operation. Three photo guide rates. Auto guider ready. Four tracking rates.

Adapter Plate. (Specify Telescope) 7 lb. counterweight. Weight capacity — 30 lbs.

$1449.00

Many optional accessories available.
Dealer Inquiries Invited

The GM-8 is perfectly suited for the following telescopes — Astro Physics 4" Traveler, Astro Physics 5" F-8, Celestron C-5, C-8, C-9.25 SCT, 25 SCT, Celestron 102 Refractor, Ceravolo HD-145, Meade 8" and 10" SCT, Meade 4" and 5" APO, Tele Vue Pronto and Genesis and new Meade 7" Maksutov.

INTRODUCING
Losmandy Digital Setting Circles

- 9000 + objects includes Messier, NGC., planets and add up to 59 of your favorites. Epoch 2000 coordinates.
- Liquid crystal display, backlit, heated.
- RS-232 Serial Port

Complete module with encoders and mounting hardware..........$695.00

SPECIAL PRICE — $595 when complete digital circles purchased with GM8/G14/G11/G9 Mount.

Tectron Collimators Improve Newtonian Images with the following:

Sight Tube	$29.
Cheshire Eyepiece	$38.
Auto-collimator	$31
Above 3 w/Bklt	$95.
New "Revised" Booklet on Collimation	$ 8

POCONO MOUNTAIN OPTICS

Price Breakthrough!—Twin Star Binocular Viewer----Attaches directly to SCT's

- 1.25" and 2.0: adapters also availale.
- Accepts 1.25" Eyepieces
- Eyepiece Angle: 45 degrees
- Weighs 1.6 lbs
- Independent Helicoid Focusing
- 55-73mm Eye Adjustment
- BAK4 (Multi Coated)
- **INTRO PRICE: $499**
- 1.25" and 2.0" adapters, $34.95 ea

THE SERIES II
GERMAN EQUATORIAL MOUNT

Ideal for Small Telescopes, Spotting Scopes and Telephoto Lenses

Featuring:

- Quick Release Dovetail Instrument Platform with Balance Adjustment
- Dual Adjustable Counterweights
- Self-Contained DC Right-Ascension Drive
- Adjustable Drive Clutch
- Declination Axis Lock
- Attaches to 1/4 or 3/8 Tripod Mount

Sale Priced
$309

Now Available with Quartz Drive..........**$435**

Now Available: Piggy back mount for attachment to Counterweight shaft — allows attachment of additional camera..........$24.00

EYEPIECE SPECIALS!!

Buy Direct & Save

Coated and threaded for filters:

1 1/4" Kellners 6, 9, 12, 18, 25, 40MM	$34.95
1 1/4" Orthos 4, 5, 6, 7, 9, 12.5, 18, 25MM	$49.95
2", 1 1/4" Eyepiece Adj. threaded for 48MM filters	$20.00

1 1/4" ERFLES

16MM	$ 65.00	25MM	$70.00
20MM	$ 69.00	1 1/4" 2x Barlow	$39.00

COMPUTER SOFTWARE

"THE SKY" by Software Bisque

The Sky, Levels 3 and 4 in stock.
CCD Soft Imaging software now in stock.

OBSERVE IN COMFORT with STAR-BOUND® VIEWING CHAIR

- Portable, Adjustable from 9" to 32"
- Padded Seat
- Porcelain Black Powder Coated

NOW ALSO AVAILABLE IN WHITE

Dealer Inquiries Invited

$159.00

-SPECIAL OF THE MONTH-

2" 2x Barlow uses B&L lens..........$139.
-Limited Supply-

Pocono gladly accepts:
DISCOVER NOVUS VISA MasterCard AMERICAN EXPRESS
with no surcharge

Visit our home page at: http://www. astronomymall.com

WORLDWIDE SHIPPING on many items ($6.00 minimum shipping/UPS) in U.S.

Purchase orders from qualified institutions gladly accepted.

We purchase and take in trade used telescopes.

CALL OR WRITE FOR FREE 35 PAGE PRODUCT CATALOG/ PRICE LIST.

NOW OPEN!

POCONO WEST OPTICS

2580 S. Decatur #3, Las Vegas, NV 89102
Fax: 702-252-7130 E-mail us at poconowest@aol.com

ORDER HOURS: 9-9 Mon.-Fri., 9-6 Sat., 10-5 Sun.
SHOWROOM HOURS: 10-9 Mon.-Fri., 10-6 Sat., 11-4 Sun.

Mention Ad A-7

BEST OF ARAS PRESENTS...

The Tour of a Lifetime

Only a few will witness the Last Solar Eclipse of the Millennium. Travel with ARAS' expert Turkish astronomers, to the centreline of the eclipse path. Plus, Best of ARAS will also explore the Sultan's Blue Mosque and the Grand Bazaar in Istanbul, the volcanic "moonscape" of Cappadocia, and ancient Roman ruins lining the Aegean Sea.

ARAS' limited 18 day + 16 night "Best of the Millennium" and 9 day + 7 night "Best of the Century" tours feature deluxe hotels, A/C luxury motorcoaches, and exciting regional cuisine.

Starts at only $1895 per person (land only).

1•800•208•2727

Don't Miss The Last Total Solar Eclipse of the Millennium!

{at centreline Diyarbakir, Turkey}

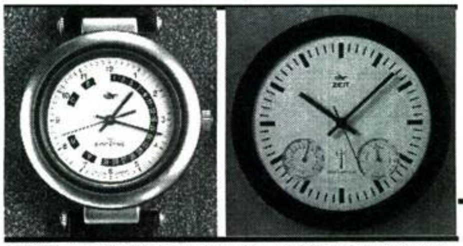
11 August 1999•12:40.21p.m. L T •02m09s 52°

"ATOMIC CLOCK CONTROLLED"
Precision Time Pieces Synchronized to the US Atomic Clock - Accurate to 10 billionths of a Second!

SALE $69

The most accurate clock on Earth. These smart clocks tune into the radio signal emitted by the **US Atomic Clock** in Colorado-which deviates less then 1 second over a million year period. They synchronize themselves automatically to the exact same time daily and adjust even for daylight savings time and leap seconds. You can now have the world's most accurate time 24 hours a day to be in control of time or start your day. These precision ZEIT timepieces are **engineered in Germany** and are **easy to use** using the latest in radio-controlled technology. Just set the time zone and the built in micro chip does the rest. **ZEIT- accurate! precise! reliable! & fully automatic**

ZEIT Atomic Wall Clock with regular or roman numbers For home or office—1AA, Large 12". **$79** ($99 in wood)



ZEIT Atomic Watches are the **world's most accurate watches** with hour, minute and seconds. Hands spin at 80 times its normal rate until they stop at the precise time. Shock-resistant polymer case with built-in receiver for Atomic Time Signal (water-resistant). Mineral lens, **black** or **white** dial &leather band. **Only $149** ($249 in Ceramic) **NEW - Digital Atomic Sportswatch with UTC etc. $99**

ZEIT Atomic Dual Alarm & ZEIT Atomic PC Sleek European design with large 2 line LCD display with exact time in hours minutes, seconds; month and date, or any two US and world times. At 8oz ideal for travel; incl. dual alarm with nightime illumination, time zones and lithium battery backup. Super sensitive built-in receiver. 2AA. incl. **Black** or **Silver** arch design at 5"x4"x2 1/2" **Sale! $69.** Buy any two Clocks **get 20% off** 2nd. **ZEIT PC** with serial cable and software for WIN. Also shows **UTC Time in 24hrs** mode. **Sale! $99**

Call for full line of atomic clocks & watches
Atomic Clock Controlled Time:
Credit Card Orders
Call toll free **1-800-985-8463** 24hrs
send checks/money orders to:
Arcron Zeit, Inc. 1010 Jorie,Oak Brook, IL 60523
fax. 630.575.0220 http://**www.arctime.com**

KENDRICK
Dew Remover
SYSTEM

A truly effective solution for the prevention of dew and frost on all optics and accessories.

		Felt lined flexible Dewcaps	
controller	$65.00	ETX	$25.00
.965"	$33.00	C5	$32.00
1.25"	$35.00	6"	$42.00
2"	$38.00	7"/C8"	$50.00
3"	$40.00	C9.25	$55.00
4"	$43.00	10"	$60.00
5"	$45.00	C11"	$70.00
6"	$48.00	12"	$85.00
7/8"	$50.00	14"	$105.00
9/10"	$60.00	**Batteries, Power supplies,**	
11"	$65.00	120v converter	$60.00
12"	$70.00	220v converter	$80.00
14/16"	$80.00	12v17AH Battery	$125.00
Telrad heater	$23.00	12V 34AH Battery	$240.00
Telescope computer control heater (Meade, Astro Physics)	$35.00	dual plug adaptor	$12.00
Laptop computer heater	$95.00	battery clip adaptor	$10.00

Our 17 amp hour 12v battery is powerful enough to drive both your scope and our heaters. This battery comes fused, with built in cigarette lighter jack, charger, rugged, soft shell carrying case and shoulder strap. Weighs 14 lbs. $120.00

Our dew caps are made of a flexible, rugged plastic. They are all felt lined and have sewn in velcro attachments. They lie flat for easy storage and transportation.
Custom sizes available.

KWIK FOCUS LENS CAPS

A simple and easy to use focusing aid for astrophotographers, CCDers and observers. Can be used as a collimator and lenscap.

Before
Kwik Focus
After

ETX	$30.00	7" Mak	$35.00		
C5	$30.00	8" SCT	$35.00	12" SCT	$50.00
AP 105mm	$30.00	9.25" SCT	$40.00	14" SCT	$55.00
AP 130mm	$30.00	10" SCT	$40.00	16" SCT	$60.00
AP 155mm	$30.00	11" SCT	$45.00		

SOLAR FILTERS FOR KWIK FOCUS

Now available for the Kwik Focus are our off axis solar filters. Coatings are guaranteed for 15 years. Transmission is1/1000 of 1%. Color is yellow orange. The filters include an adaptor that is epoxied into one of the holes of the Kwik Focus. Solar filters can then be screwed in for solar viewing. **52mm.....$95.00 82mm.....$119.00**
Solar Filters for ETX, AP refractors available.

LASER COLLIMATORS

2"......$125.00 1.25"...$95.00
Auto on / Auto off Batteries included
Has adjustments to take up slack between focuser and laser.
Makes precise collimation very easy.
2" to 1.25" adaptor for tall focusers...$20.00

OBSERVING CHAIRS

Made from Baltic Birch plywood.
Fully adjustable seat.
Standard model...$125.00
Deluxe model......$160.00
(comes with attached folding accessory tray. Holds up to 5 eyepieces, charts and more.)

ASTRONOMY TENTS

A portable camping/observatory tent for the astronomer on the go.
Quick set up time of about 10 minutes. Comes with an adjustable rain fly which is easily rolled back from the observatory room.
Has two rooms, one for observing, another for sleeping or for use as a computer or chart room. The tent also makes a great family camping tent when not obserivng.
The observatory side has an adjustable zip out roof and zip out bug netting to help control light intrusion and wind. This tent can handle up to a 12" Schmidt Cassegrain, 6" refractors (F8), 16" F4.5 equatorial mounted Newtonians and some dobsonian telescopes.
DIMENSIONS - 15' X 9' X 6'6"
WEIGHT - 30 lbs (13.5 Kilos)
$390.00

A portable shelter for tthose seeking protection from annoying street lights and mild winds. Two adjustable observing slots - one on the front the other on the back. Made rom military spec fabric reinfrced vinyl. Absolutley light and wind proof. Black on the inside, white outside. Easy to set up and take down. Set up time is 10 minutes. The tent has a dimension of 10' L x 7'W x 7'H. Lots of room for a scope, a table and one or two observers. Has a large door for easy equipment manouvering. Can be made to be free standing. It has an open floor. A rain fly is not offered with this tent. Set it up in your driveway, on your deck, in your back yard or your favourite observing site.
Price..$325.00
Carry bag..$40.00

All Major Credit cards accepted
Buy direct or from your favourite dealer
JIM KENDRICK STUDIO
2775 Dundas St. W., Toronto, ON M6P 1Y4, Canada
P 416 762 7946 F 416 762 2765
Order line 1 800 393 5456
http://www.kendrick-studio.com

ODYSSEY®
TELESCOPES
Seeing the *real* Universe

PRESS RELEASE:

MURNAGHAN Instruments Buys Coulter Optical Assets. Production of **Odyssey® Telescopes** will continue. New product benefits from financial stability and management of MURNAGHAN Instruments Corporation.

THE ODYSSEY™ ADVANTAGE
- No assembly required
- Improved Dob mount and Focuser
- Double-strength Sonotube
- Eyepiece included
- Many options available
- Lowest prices anywhere

8-INCH f/4.5 $399.95
- Deep-space scope
- Tube 36 x 10.5 inches
- Diffraction-limited optics
- Includes wide-field eyepiece
- Reengineered mount system

8-INCH f/7 $399.95
- Lunar/planetary scope
- Tube 56 x 10.5 inches
- Diffraction-limited optics
- Includes high-magnification eyepiece
- Extra-stable mount

10-INCH f/4.5 $549.95*
- Extremely portable
- Tube 45 x 12.7 inches
- Diffraction-limited optics
- Includes wide-field eyepiece
- Improved mount system

** For orders placed after 7-1-97*

13.1-INCH f/4.5 $799.95
- A BIG scope for less money
- Easy 1-person setup
- Tube 57 x 15.7 inches
- Diffraction-limited optics
- Includes wide-field eyepiece

HOW TO ORDER

Send no money. A deposit is **NEVER** required to process your order. Pay just before shipment by check, money order, Visa, or MasterCard.

For orders or information: Call 1-561-795-2201
***E-Mail:* murni@bix.com • *Web:* www.murni.com**
Fax: 1-561-795-9889

The New
Coulter Optical®
Div. MURNAGHAN Instruments
1781 Primrose Ln.
West Palm Beach, FL 33414
Bigger Scopes . . . Better Optics . . . *Less Money*

CCD IMAGING EQUIPMENT™
- CCD Cameras
- Filter Wheels motor or manual
- ALL CCD Filters
- Flip Mirrors
- Beam Splitters
- 1.25, 2-in. & T-mounts

Flip Mirror - Find & Focus *Fast*

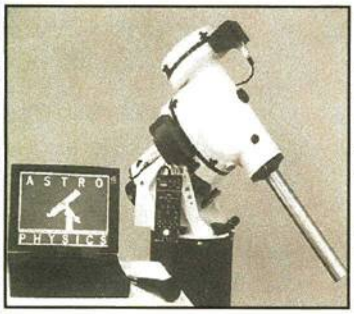
Equipment for **ALL** CCD's **AND** visual use.

MURNAGHAN™ Instruments
1781 Primrose Ln., W. Palm Beach, FL 33414
Phone: 561-795-2201 • FAX: 561-795-9889
WWW Catalogs: http://www.murni.com
E-Mail: murni@bix.com

"GREETINGS STAR VOYAGER
Allow me to be your guide on a wonderful journey through the cosmos. I await your command."

Astro-Physics 1200GTO, 900GTO, 600EGTO German Equatorial Mounts with Servo Drive, Go-to Keypad, DigitalSky Voice™ Software

Imagine...a voice-activated, computer-controlled mount slewing from one end of the sky to the other with simple commands like "M1" or "Find Neptune."



1200GTO German Equatorial with Servo-Drive, DigitalSky Voice™ (Laptop not included)

- Zero-cogging, precision servo-motor with microprocessor control to an accuracy of ± 0.05 arc seconds per step
- Fast-slewing at 5 degrees per second
- Accurate sidereal motion ± 5 arc sec. periodic error
- Portable, very solid, vibration-free construction
- RA/Dec axes come apart without tools for easy transport
- Go-to keypad controller with PEM (permanent error memory), declination backlash control
- Ready for CCD autoguider and imaging cameras
- Ideal for CCD imaging and astrophotography
- Comes with DigitalSky Voice™ Software
- Fully compatible with Software Bisque's TheSky™

DigitalSky Voice™
Telescope Control System Software

DigitalSky Voice™ software ushers in a new era in telescope control systems. You can now establish two-way verbal communication with your mount, via your computer, slewing with ease from one object to another. Or, if you prefer, you can direct the movement of your scope with a few mouse clicks at the computer. Couple this revolutionary software with a superb Astro-Physics mount or any mount that uses the Meade protocol and enjoy a view of the universe from your own starship.

- Telescope slews to object you specify from extensive databases or any RA/Dec coordinate; or use common names such as "Find the Ring Nebula"
- Retain your dark adaption; eliminates need to look at your laptop
- Provides extensive information about object you view
- Easy two-star polar alignment
- Tours-predefined sequences of objects to view
- Intuitive computer interface, easy to use
- Use with Astro-Physics computer mounts or any mount that uses Meade protocol (LX200, LXD500, LXD650, LXD750)
- High coolness factor

DigitalSky Voice™ software

ASTRO-PHYSICS, INC, 11250 Forest Hills Rd, Rockford, IL 61115
Phone: 815-282-1513 Fax: 815-282-9847

LOOK

THE A LIST:

Our understanding of astronomy leaped ahead with each of these 25 greatest findings of all time.

- *In 1965 Caltech astronomer Maarten Schmidt identified "quasi-stellar objects," radio sources known as quasars, which subsequently were found to be the highly energetic centers of young galaxies.*

- *At Bell Laboratories in New Jersey, in 1965–1966, Arno Penzias and Robert Wilson identified the 3° K background radiation, the echo of the Big Bang.*

- *The first pulsar, CP 1919, was found by Jocelyn Bell of Cambridge University in 1967. Astronomers found that pulsars were rapidly spinning neutron stars.*

NASA/JPL
Venus

- *In 1609 Galileo Galilei turned his telescope skyward and discovered the phases of Venus, satellites of Jupiter, stellar nature of the Milky Way, and numerous craters on the moon.*

European Southern Observatory
Galaxy Harboring Black Hole

- *In 1992 astronomers discovered the first planets outside our solar system (orbiting a pulsar!) and three years later detected the first planets around a sun-like star.*

- *Observations made with the Hubble Space Telescope in the early 1990s confirmed that supermassive black holes exist in the hearts of some galaxies, the first proof that black holes exist.*

- *In 1687 Isaac Newton's* Principia *was published and finally proved that the sun lay at the center of the solar system.*

- *German-English amateur astronomer William Herschel discovered the planet Uranus in 1781.*

- *In 1801 Italian astronomer Giuseppe Piazzi recognized the first known asteroid, 1 Ceres.*

- *After an exhaustive search through millions of star images, young American astronomer Clyde Tombaugh spotted Pluto on a pair of glass photographic plates in 1930.*

- *Based on a mathematical calculation by Urbain Le Verrier, German astronomers Johann Galle and Heinrich D'Arrest spotted the planet Neptune in 1846.*

- *In 1864, with the new technique of spectroscopy at hand, English astronomer William Huggins discovered that nebulae are composed of gas rather than innumerable stars.*

- *American astronomer Edwin Hubble demonstrated in 1923 that galaxies are separate island universes of stars outside the Milky Way.*

- *In 1931–1932, using his Bell Laboratories antenna in Holmdel, New Jersey, Karl Jansky detected radio energy from the Milky Way, initiating radio astronomy.*

Small Magellanic Cloud
Luke Dodd

BACK

BIG DISCOVERIES

NASA/JPL

Uranus

- American astronomer Harlow Shapley produced studies of globular star clusters in 1918 that first accurately defined the shape and size of the galaxy.

- In 1908 a meteorite or cometary fragment exploded over Tunguska, Siberia, giving scientists the chance to document the resulting damage.

- In 1675 Danish astronomer Ole Rømer accurately measured the speed of light, establishing a basis for understanding many astronomical phenomena.

- From 1834–1838, English astronomer John Herschel undertook a massive program of discovery in the Southern Hemisphere from the Cape of Good Hope, cataloging thousands of sky objects.

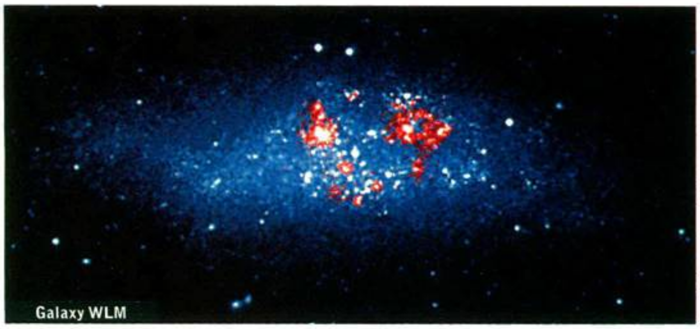
- Henrietta Swan Leavitt completed studies of the Small Magellanic Cloud in 1912 that led to the development of the period-luminosity relationship for Cepheid variable stars, a technique that enabled estimating their distances.

- In 1543, Copernicus published *De Revolutionibus Orbium Cœlestium*, sparking the Copernican revolution, which ultimately led to understanding the true structure of the solar system.

Behran Anita, UCB/CEA

Quasar BL Lacertae

- French mathematician Pierre Simon Laplace described in 1796 his "nebular hypothesis" of the origin of the solar system, which basically correctly identified how the sun and its planets came to be.



Royal Observatory, Edinborough

Galaxy WLM

- In 1761 Russian astronomer Mikhail Lomonosov discovered during a transit of Venus that the planet had an atmosphere, confirming that planets in the sky were other worlds perhaps like Earth.

- American astronomer Henry Norris Russell in 1913 announced his theory of stellar evolution, which made possible understanding how stars age and led to the organization of the Hertzsprung-Russell diagram.

- In 1890 Harvard astronomer Edward C. Pickering and Antonia C. Maury proposed a classification scheme for stars based on their spectra that is the backbone of understanding stellar properties.

- German astronomer Friedrich Wilhelm Bessel in 1838 announced his determination of the first calculation of a star's distance by parallax, for 61 Cygni, arriving at 10.3 light-years.

A combative physicist says 25,000 comets puncture

SEEING

Earth's upper atmosphere every day,

SPOTS

but critics find holes in the data. **by Kathy Sawyer**

It is a shocking notion. Radiation-blasted, black-jacketed snowballs the size of houses swarming out of the cosmic void by the thousands every day, plowing into Earth's atmosphere and pancaking explosively into clouds of vapor that fall as gentle rains. Over billions of years, these invaders might have filled Earth's oceans and provided the seeds of life. And yet they elude detection by the planet's most advanced military and civilian detectors, revealing themselves primarily to one mortal — a contentious, meticulous, workaholic physicist with a fondness for the isolation of Iowa soybean fields.

The stealth snowballs burst into the headlines on April Fool's Day 1986, leading some to dismiss them outright as a joke. But University of Iowa physicist Louis Frank wasn't fooling. His stunning hypothesis ignited an angry feud now burning into its second decade.

At the heart of the controversy is an absence of light: pesky, dark spots that Frank found peppering his ultraviolet satellite images of the Earth's radiant sunlit face "like flies walking across a television set." Despite what critics describe as an absence of corroboration, the physicist maintains that these spots, which he calls "atmospheric holes," are the signatures of fluffy snow comets, each weighing 20 to 40 tons, that disintegrate in Earth's atmosphere at the rate of 25,000 a day.

Frank, 59, is not easy to dismiss. He is an accomplished plasma physicist who has flown experiments on more than 40 spacecraft (a world record, according to NASA colleagues) and currently is a principle investigator for instruments on three space missions: NASA's Galileo, which is investigating Jupiter and its largest moons; Polar, a high-altitude satellite designed to study the flux of energy between the sun and Earth; and the international Geotail, which also is studying sun-Earth interactions. Frank's laboratory at the University of Iowa, which designs, builds, and tests space science instruments and analyzes data, was established by his Iowa mentor, James Van Allen, the space-age pioneer who discovered Earth's radiation belts.

THE SNOWBALL FIGHT most likely would have melted away if not for Frank's unshakable confidence in his intellectual abilities and in what he believes. A healthy ego and combative spirit are common, even essential, traits among cutting-edge researchers, but some of Frank's colleagues complain that he stands out, often appearing to be insolent. "Face to face with an adversary, he can be scathing and insulting. Many people want him to fail," says Thomas Donahue of the University of Michigan, a leading atmospheric physicist and former critic of Frank who now believes his findings merit further research.

Frank agrees, matter-of-factly. "I am a very hard man to deal with. Some people live just to catch me in a big error . . . I don't make mistakes. I know you think that's arrogant. But I have dedicated my life to my work and when I 'go,' I'll know that everything I did was of the highest quality."

On the contrary, Frank's critics argue. They say his spots are nothing more than instrumental noise (like static) — that he is wildly over-interpreting. "On the basis of the data I have examined through rigorous statistical analysis, there is not a shred of evidence that the dark spots are physical," says University of Washington geophysicist George Parks, whose ultraviolet imager rides aboard the Polar spacecraft on the same platform with Frank's instrument.

And even if the spots represent something real, critics say, there is no evidence of such huge numbers of objects or such abundances of water anywhere except in Frank's interpretation. Such a bombardment should flash gaudily in the darkened skies at every dawn and dusk; the comets' accumulated fallout should have formed a glowing cloud of hydrogen around Earth, and, they should trigger constant moonquakes as they hit the lunar surface. A spaceborne experiment recently reported detection of excess water in the upper atmosphere, but it was only 10 percent of what Frank's comets should deliver. The list of objections goes on.

"I DIDN'T REALIZE — nobody did — the difficulty involved in doing a confirmation," says astrophysicist Robert Hoffman of NASA's Goddard Space Flight Center, who is coordinating an interagency effort to provide independent verification of the snow comets.

"Frank's strength is the consistency of his separate investigations. They all hang together and . . . they have gone through peer review by supposedly knowledgeable people," he says. "On the other hand, the objections cause me problems."

In an era when humans have peered virtually all the way to the edges of the known universe and Earth's skies are filled with a diversity of advanced satellite technologies monitoring Earth's environment, it is hard for most people to understand how such a flamboyant phenomenon as a high-frequency barrage of snow comets could be so elusive. Is this kind of prolonged and bitter skirmishing among scientists a healthy rite of passage for a new theory? Or is it true, as some of Frank's critics have suggested privately, that he has turned the scientific process "pathological" by defending his theory so stubbornly.

Paul Feldman of Johns Hopkins University, who specializes in spectroscopic studies of comets, says, "For someone to pursue an idea like this so doggedly . . . really shows a determination and perseverance that's extraordinary. He'll probably defend his idea to the death. But it is also completely contrary to the scientific method."

Frank suggests a contrary view — that he is waging battle against orthodox science (as embodied in his dozen or so critics), which throws up a punishing barricade against ideas that threaten the conventional wisdom. "My life would have been a lot easier if I had just put all of this in one of my drawers here," he says. But he feels a moral obligation to defend his data and to defend "the right of young people to be able to develop their own ideas . . . I come from a strict family. I was raised to have honesty and integrity. So I had no choice." Hoffman is dismayed that some of Frank's critics have pressured the NASA panel to "declare the issue dead."

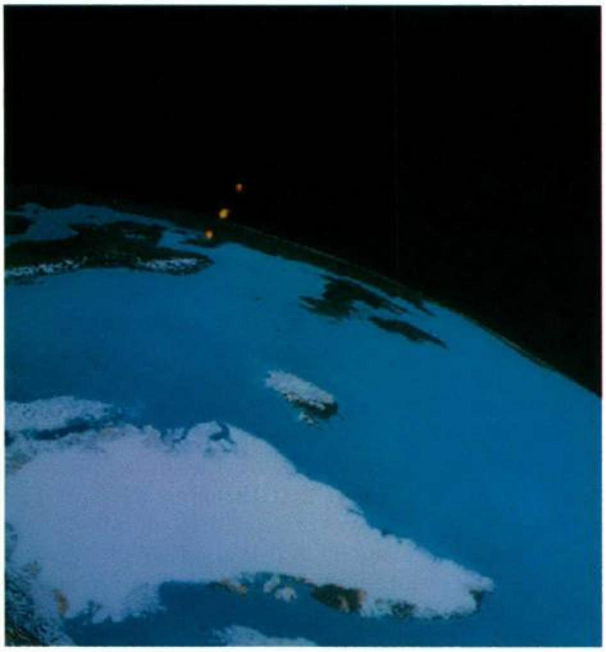
Astronomer Stephen Maran, a spokesman for the American Astronomical Society, says, "Most times, scientists defer to a consensus. If they didn't, they'd never get any work done. As a practical matter, you can't get to the bottom of every issue yourself."

THE FRACAS MAY BE FUN for those who enjoy watching a physicist with an alluring, revolutionary new idea pit himself against the establishment. On the other hand, a host of established scientists say it is a huge waste of time and resources. Says Parks, "The bottom line is that Frank is a 'believer' and does very little analysis. And whatever analysis he has done is weak and sometimes incorrect."

Some of Frank's adversaries compare the case to that of the French scientist who, early in this century, created a stir with his discovery of N-rays that enabled the human eye to see in the dark. He was exposed as delusional. But Frank and others prefer to invoke the case of Alfred Wegener, who in 1912 developed the theory of continental drift, only to see it rejected by fellow geologists for 50 years. The theory was finally accepted — after Wegener's death.

The case is a reminder of the lonely calculus of risk and reward the scientist may face as he brings his instincts to bear on evidence that seems outlandish but could be revolutionary. How far should he go in defense of an interpretation that may be embarrassingly wrong? How far should his critics go to knock down an idea that may have merit?

Ironically, Frank at first found the dark spots a huge annoyance. He says they distracted him from his real work. Few labored harder than he did, in the early years, to make them go away. By Frank's own description, it seems that no one has felt more trapped and frustrated at times by their haunting signals. He recalls warnings from friends that he could ruin his career. He was ridiculed at meetings, he says, and the work required such long hours that he neglected his then wife (they are now divorced) and two daughters.

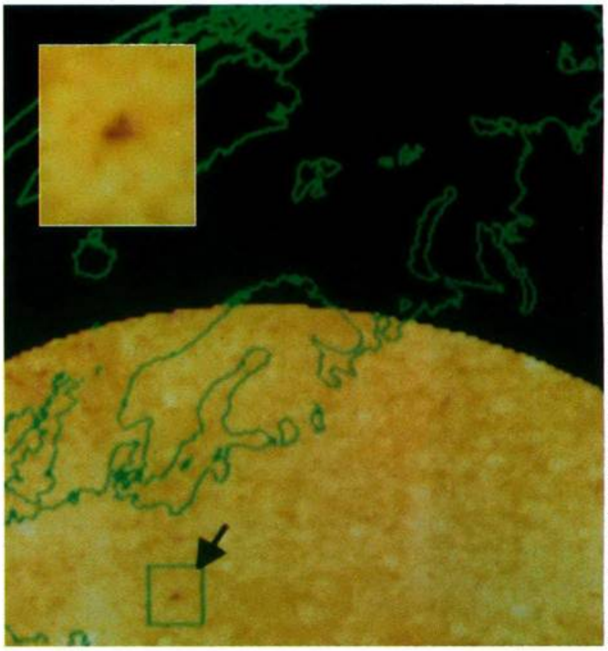


These intense "glows" taken by the Polar spacecraft about six seconds apart on December 31, 1996, are about 2,000 miles above Earth, which is artificially superimposed in this picture.

FRANK BEGAN SEEING SPOTS, so to speak, as early as 1981, in data collected by an ultraviolet camera aboard a new high-altitude, polar-orbiting satellite called Dynamics Explorer 1 (DE). He was studying one of his favorite subjects — aurorae — in images of the invisible ultraviolet dayglow emitted when sunlight is scattered by the atomic oxygen in Earth's upper atmosphere. But there were those infernal spots.

He found 30,000 spots in 2,000 hours of DE observations. He and his team, then-graduate student John Sigwarth and physicist John Craven, first looked to equipment flaws as the source. They checked for computer glitches, radio transmission noise, bad sensors, even paint flecks on the cameras. They sought advice at scientific meetings. Only after several years of this, Frank recalled in his 1990 book, *The Big Splash* (written with Patrick Huyghe), did they conclude that the spots had to be real. The spots even varied in tandem with meteor showers as detected by ground radar. Frank then constructed, step by step, the elaborate hypothesis of the small comet swarm — their quantities, origins, appearance, and so on.

The most likely cause of the dark spots, Frank reasoned, was water, a common molecule that absorbed at the wavelengths detected by his camera. If an incoming comet traveling at 22,000 miles per hour were to vaporize between the camera and the glowing oxygen layer, it would create the right signature. Each of these water vapor footprints measured 15 to 25 miles in diameter and was thinner than a London fog. But these footprints typically vanished in moments. To create the spots, he calculated that the water vapor clouds had to measure about 30 miles across and the transitory clouds would number in the millions each year. This represented an infall of material about 10,000 times more than anyone had ever imagined, in objects of a type that had been predicted in no theory. (He subsequently lowered the estimated mass of each snow comets from 100 tons to between 20 and 40 tons.)



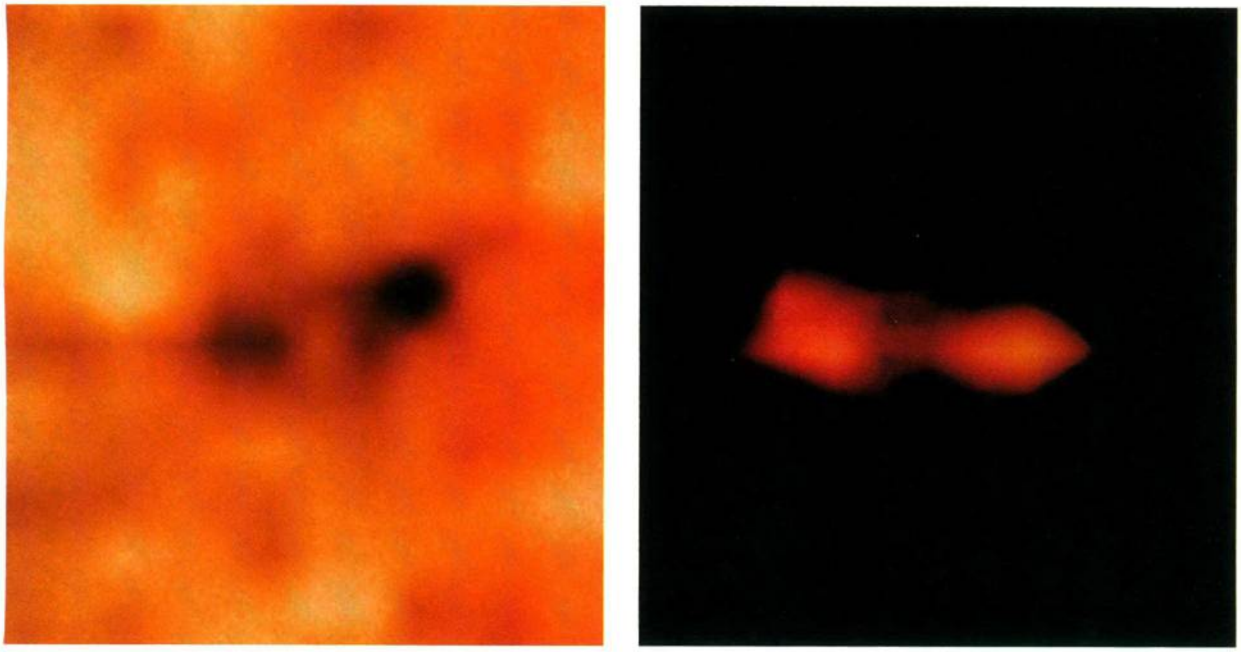
Are the dark pixels in this image (and inset) caused by instrumental artifacts in a Polar spacecraft camera or by water left by a comet impact? A map is superimposed on the image.

All photos this spread: Arc Science Simulations, University of Iowa, NASA

There is plenty of evidence that Earth is subject to bombardment by space debris. But the ordinary comets familiar to scientists are a million to a billion times more massive than Frank's snowballs. Ordinary comets are chunks of ice and dirt thought to reside in a great cloud on the outskirts of the solar system and sometimes fall in toward the sun. Their courses might be altered by encounters with the planets or by sudden eruptions of vapor jets on their own surfaces.

Frank's fluffy objects couldn't contain much dirt, or scientists would have measured at least 10,000 times more extraterrestrial dust on Earth. But to survive as they neared the sun, objects made of water-ice must have a protective armor. Frank learned about lab experiments showing that an object of ice that also contains organics, if bombarded with radiation of the sort found in space, can acquire a durable, thin black crust.

WITH HIS AGGRESSIVE RESPONSE to every objection, researchers noted, Frank was able to shift the burden of proof from himself to his adversaries. "I don't give myself high marks for how I handled it," says Alex Dessler, now at the University of Arizona, who as editor of Geophysical Research Letters first published Frank's hypothesis but later joined the opposition. "I let Frank continue to write replies that could not pass peer review . . . Most scientists, when they're caught with a series of fatal objections, just don't respond."



An unintended swaying of the Polar spacecraft on April 6, 1996, creates a double-vision effect as seen on a single star, Beta Chamaeleon, right, and one of Louis Frank's atmospheric holes, left. Frank argues that because both objects generate double images, they amount to strong evidence that atmospheric holes are due to comets, not instrumental artifacts.

Frank made his objects into "designer comets," says Feldman. "Each time an objection was raised, he would change them to fit."

Still, as the years passed, many assumed the issue had died a quiet death. However, Frank and Sigwarth reincarnated it at the spring 1997 meeting in Baltimore, Maryland, of the American Geophysical Union. They presented a new array of evidence taken in both ultraviolet and visible wavelengths, with a far more sensitive three-camera array.

Frank had spent 10 years developing the array to fly aboard NASA's Polar satellite. His new evidence included images of the comets' light trails at heights ranging from 600 to 15,000 miles and of the glow created when hydrogen atoms are stripped of water molecules. The latter was described by Robert Meier of the Naval Research Laboratory, a former critic of Frank's theory, as "kind of a smoking gun for water."

Though the basic outlines of the pro and con arguments have changed little since the mid 1980s, the opposing camps have marshaled increasingly detailed evidence from ever more sophisticated instruments, generating a dozen or so papers since the Baltimore announcement. But there are few cameras in space capable of verifying the observations independently, Hoffman and others say, and some aspects of the complex instruments aboard Polar are poorly understood.

FRANK'S OPPONENTS SAY he has not met his first burden of proof; to demonstrate that the spots represent real physical objects. Frank and his adversaries agree that the data are inherently noisy, but Frank sees something real outside the noise level. The teams use statistical methods to run computer counts of the photons (particles of light) that fall on the pixels (picture elements) of their instruments and search for the dark pixels in which the intensity of light varies from an arbitrary average. Their techniques vary. For example, Parks examines the entire imaging plane, while Frank examines smaller regions around the dark pixels.

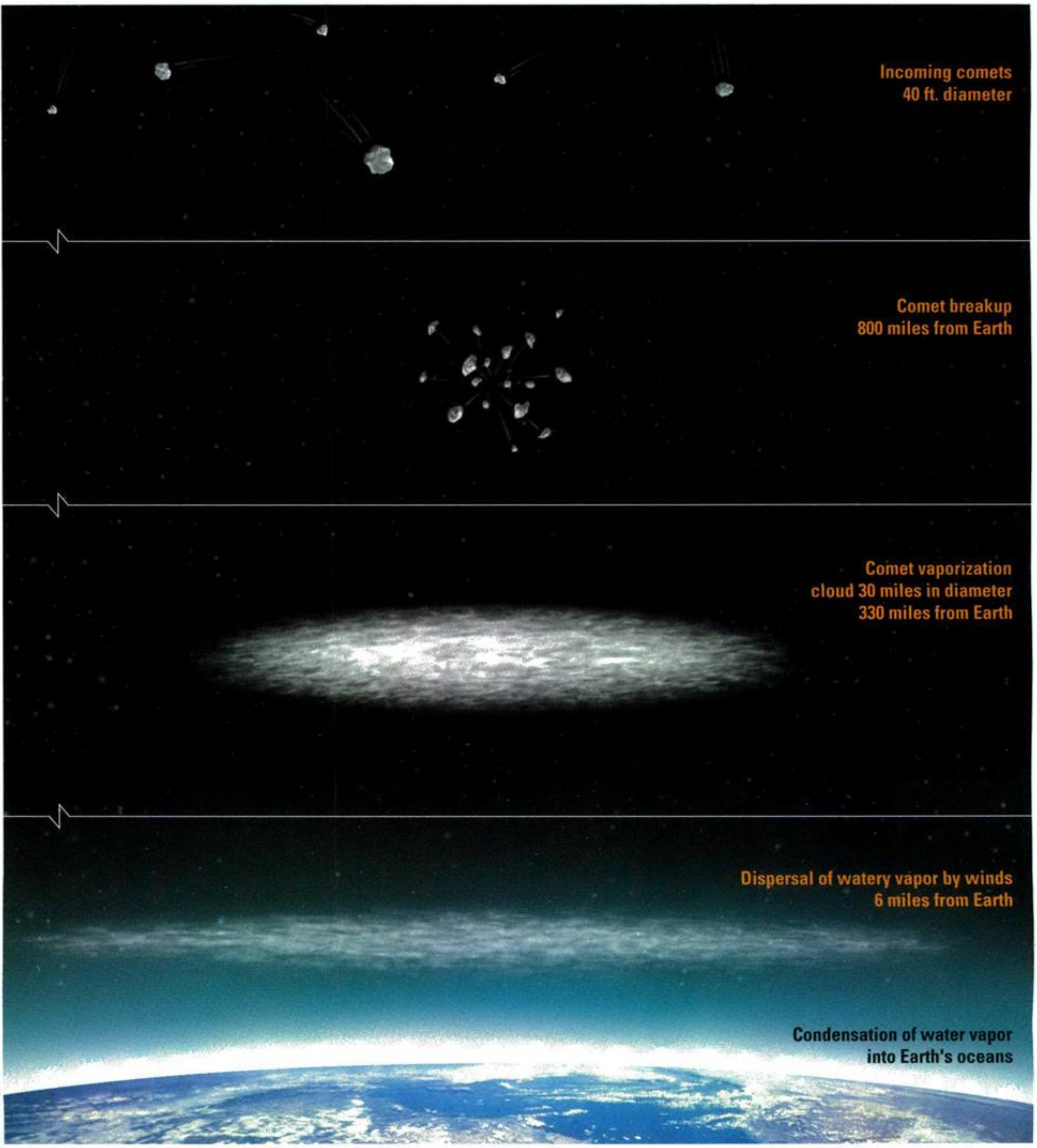
Though Parks's instrument had a troubled history before he joined the project, Parks has the advantage of laboratory images taken before the spacecraft left the ground, when a uniform ultraviolet light was shone on his detector so that it could be calibrated. Parks found that Frank's actual observations of Earth's dayglow looked the same as those from the lab calibration images. In other words, in Park's interpretation, any ultraviolet light source — even in a laboratory — will produce dark spots.

However, Parks had only five calibration images, so his light curves couldn't extend out to the realm of low statistical probabilities — the realm where Frank claims the real geophysical events are seen. The images of actual dayglow emissions taken from space show more clusters of dark pixels than do the five comparable calibration images. Frank says, moreover, that he spent the Christmas holidays in a painstaking inspection of 4,000 of Parks's images. "I found 11 'holes' . . . You're looking for something just half the size of Long Island. It destroys your eyes."

Another Polar mission scientist, Forrest Mozer, of the University of California at Berkeley, conducted an analysis of Frank's raw data on 700,000 examples of small comet observations, published on the World Wide Web, to see if there was internal consistency. He, too, failed to confirm the comets.

In addition to the dark spots, however, Frank points to separate "geophysical" evidence showing the objects are real. For example, the objects grow larger and more numerous, then smaller and fewer, as the spacecraft swings between orbital altitudes of 5,000 km (3,100 mi) and 50,000 km (31,000 mi). He also sees differences from morning to afternoon, he says. Also, an unintended wobble in the Polar platform causes any object in its line of sight to appear double, like cat's eyes, and the spots do. If the spots were produced only by noise in the instruments, they should be independent of spacecraft altitude, motion, or time of day.

But Parks and others say these effects are illusory or don't fit. For example, the apparent size varies much less than the required factor of 100 as the Polar spacecraft goes through its orbit.


Incoming comets
40 ft. diameter
Comet breakup
800 miles from Earth
Comet vaporization
cloud 30 miles in diameter
330 miles from Earth
Dispersal of watery vapor by winds
6 miles from Earth
Condensation of water vapor
into Earth's oceans

Astronomy: Terri Field

EVEN THOSE WHO ARE OPEN to the possibility that Frank is seeing something real have trouble with his comet hypothesis. They can't explain the lack of corroborating evidence anywhere — from Earth's water budget to the surface of Mars. The most compelling objection is what some call the "silence of the moon." Seismometers left by Apollo astronauts have failed to register the slightest hint of impacts, which could hardly be avoided if the comets are real. Recently, a University of Arizona team estimated that a snow comet should jar the lunar surface almost once a minute, digging a crater 50 meters across or — at the very least — throwing up a fan of lunar soil. But images from the Clementine satellite in 1994 found the surface undisturbed since the Apollo images taken decades earlier.

Frank says the snowballs land like powder puffs, leaving little trace. "Would you rather throw a rock or a snowball at your car?"

The physicist says he agrees with his detractors on at least one point: that in order to be credible and widely accepted, any confirmation should come from a research team that does not include him. But, according to Hoffman, "It's a Catch-22" in which NASA officials are reluctant to put up money for such studies until there is proof that the objects are real, but to secure such proof requires more funding.

The most direct type of observation could be done by a military surveillance system designed to look for the infrared signal of hot water from rocket plumes, Hoffman says. A study has determined that the instrument would have to aim at Earth's limb in order to detect the signal of excess cold water from the descending vapor clouds. The best such facility for the job, he says, is Johns Hopkins Applied Physics Laboratory's MSX (Midcourse Space Experiment), a Ballistic Missile Defense system. But, he added, the observing program would cost about $1 million and there is no plan to attempt it.

Another approach is to try to catch the small black comets hurtling through space, using optical telescopes or radar. In 1988, the late astronomer Clayne Yeates, of the Jet Propulsion Laboratory, used the Spacewatch telescope at Kitt Peak in Arizona for such a search. As if he were aiming a shotgun at a skeet shoot, Yeates used Frank's computations as a guide to locate the invisible targets and then swung the telescope at the proper speed. He claimed to have confirmed the objects' existence, but the scientific community rejected the results as ambiguous.

MORE RECENT ATTEMPTS by Spacewatch, Massachusetts Institute of Technology's Lincoln Laboratory, and the joint NASA/Air Force Near Earth Asteroid Tracking System (NEAT) have failed to confirm the snow comets. "Assuming Frank's comets are as dark as normal asteroids, we can claim [they] are at least a million times less abundant than he has concluded," says Eleanor Helin of JPL, the lead NEAT scientist. "If they are much darker, reflecting at least 100 times less light than normal asteroids, then . . . we wouldn't see them."

Sigwarth, who has worked closely with Frank since 1980, when he was a freshman undergraduate of 19, says, "The ferocity of the debate has surprised me." But he shares Frank's conviction about "what the data are saying." Craven, a co-author on the first comet paper, now at the University of Alaska in Fairbanks, still works with Frank — not on small comets but on Polar observations of aurorae. Regarding atmospheric holes, whatever they may turn out to be, he mused, "There's enough in the data that it makes me wonder sometimes, what have we missed?"

Frank, when not attending scientific meetings, drives his pickup truck between the lab and his home, a hideaway surrounded by a nine-foot-tall, partially electrified fence, within which he has built his own nine-acre park with some plantings in formal geometric areas and others in dark woods. "I like the isolation."

All photos of Louis Frank/Brian Ray

University of Iowa physicist Louis Frank says some people would love to catch him in a big error.

He has found the small comet ordeal lonely and painful, though not suspenseful. "I'm not worried. The atmospheric holes are there and you're not going to get rid of them . . . It's all going on right now, 100, 200 miles over our heads." ■

Kathy Sawyer is a science writer for the Washington Post.

SOLAR SYSTEM

Redeux

Science has modified our view of home turf, adding chaos, rogues, and errant comets.

by John P. Wiley, Jr.

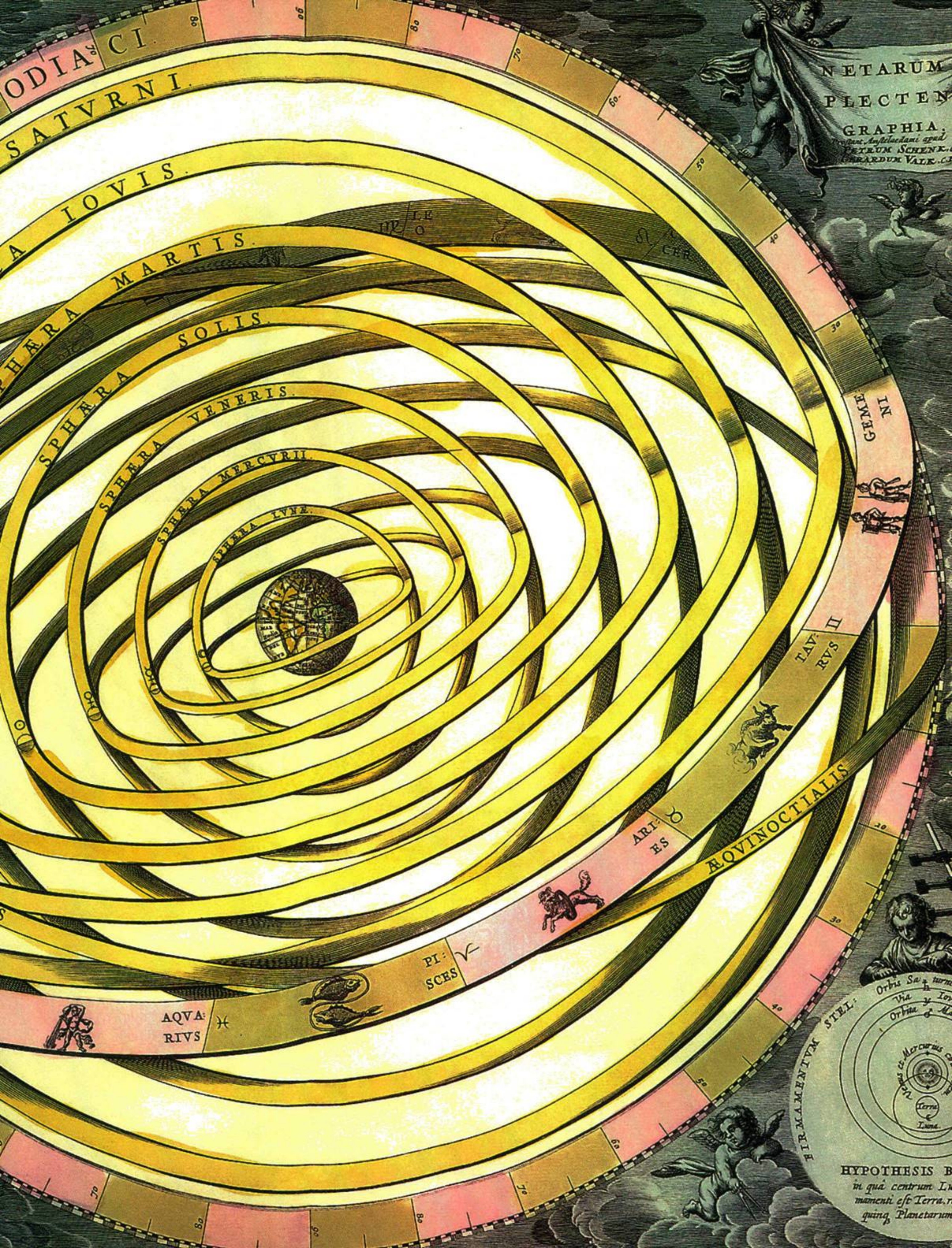
AN ORRERY, ONE OF THOSE MODELS OF THE SOLAR SYSTEM IN WHICH the planets circle a globe representing the sun, hung in the lobby ceiling of the old Hayden Planetarium in New York. Children and adults alike were mesmerized, watching the inner planets soar smartly around their orbits, while the larger, outer planets moved more slowly, with the stateliness of great blue herons. It all seemed so well organized and so unmessy, a solar system in the Disney tradition.

Future astronauts, it was true, were going to have to be careful driving through the asteroid belt, but that wasn't something to worry about today. Meteors were real and now, both the phffts in the sky on a clear night and the possibility of larger ones, such as the 19-ton iron meteorite from Greenland behind the orrery watchers in that same planetarium, a shiny dark Henry Moore sculpture that any art museum director would kill for. Comets were something one read about in history books.

Basically, however, the solar system was a tight ship. Everything Bristol-fashion. Orderly. Disneyish.

Well, it's time to wake up, America. The solar system is a dusty, dirty place filled with flying missiles, some of which could hit Earth. It's a

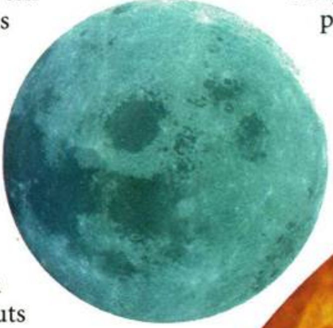
ORBIUM PLA
ERRAM COM
TIUM SCENO
SPHÆRA
SPHÆRA
SPHÆRA
SPHÆ
SCOR PIVS
CIRCVL
CAPRI: CORNVS
THESIS PTOLEMAICA
quâ Terra totius Univer: si centrum


ODIA CI.
SATVRNI.
IOVIS.
MARTIS.
SPHÆRA SOLIS.
SPHÆRA VENERIS.
SPHÆRA MERCVRII.
SPHÆRA LVNÆ.
LE O
CER
GEME NI
TAV RVS
ARI ES
ÆQVINOCTIALIS
PI SCES
AQVA RIVS
80
70
60
50
40
30
20
NETARUM
PLECTEN
GRAPHIA,
Prostant Amstelaedami apud
PETRUM SCHENK.
GERARDUM VALK.
FIRMAMENTVM STEL:
Orbis Saturni
Via Iov
Orbita Ma
Venus et Mercurius
Terra
Luna.
HYPOTHESIS B
in quâ centrum Lu
mamenti est Terra,
quinq, Planetarum

place where large objects come barreling in from beyond the planets: asteroids from an enormous region called the Kuiper Belt and comets from farther away still, a place called the Oort Cloud that reaches halfway to the next star. These last are the ones that come streaking in, shining like a searchlight in the night, crack the whip around the sun, and race away along the open ended curve of their hyperbolic orbit, some never to return. Now that's a visitor from outer space.

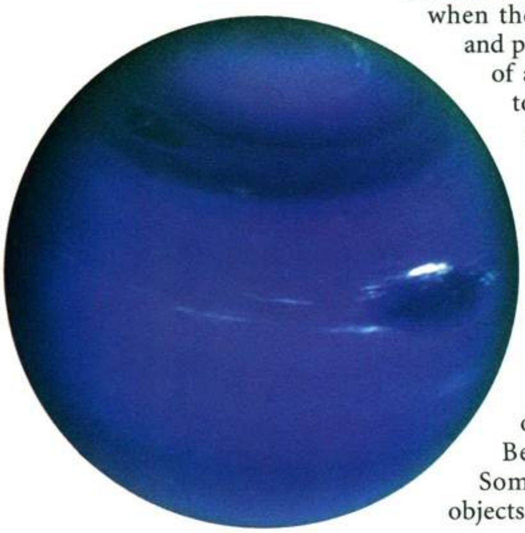
Sooner or later one of these objects and Earth will arrive at the same place at the same time. Enough said.

Back on Earth, we're all reading about those house-sized objects raining down on us from interplanetary space. They may or may not be ice, as their discoverer claims, but he's certain they're with us. Not subject to debate are the data recently released by the military, showing that incoming rocks explode with the force of 1,000 tons (one kiloton) of TNT on an average of once a month. (About once a year, apparently, a 15-kiloton blast goes off above our heads.) Plain old dust, left over five billion years later from what once was an accretion disk around our proto-sun, doesn't get much attention, even though ten thousand tons of the stuff drift down on us every year. When conditions are right, you can see this interplanetary stuff before sunrise or after sunset as a luminous triangle known as the Zodiacal Light. (Just like the planets and almost everything else, the dust lies mostly in the plane of the ecliptic or, as we say, along the Zodiac.) Face it: As a planet we're traveling in a cloud of dust; Earth bears a certain resemblance to the Peanuts comic-strip character Pig Pen.



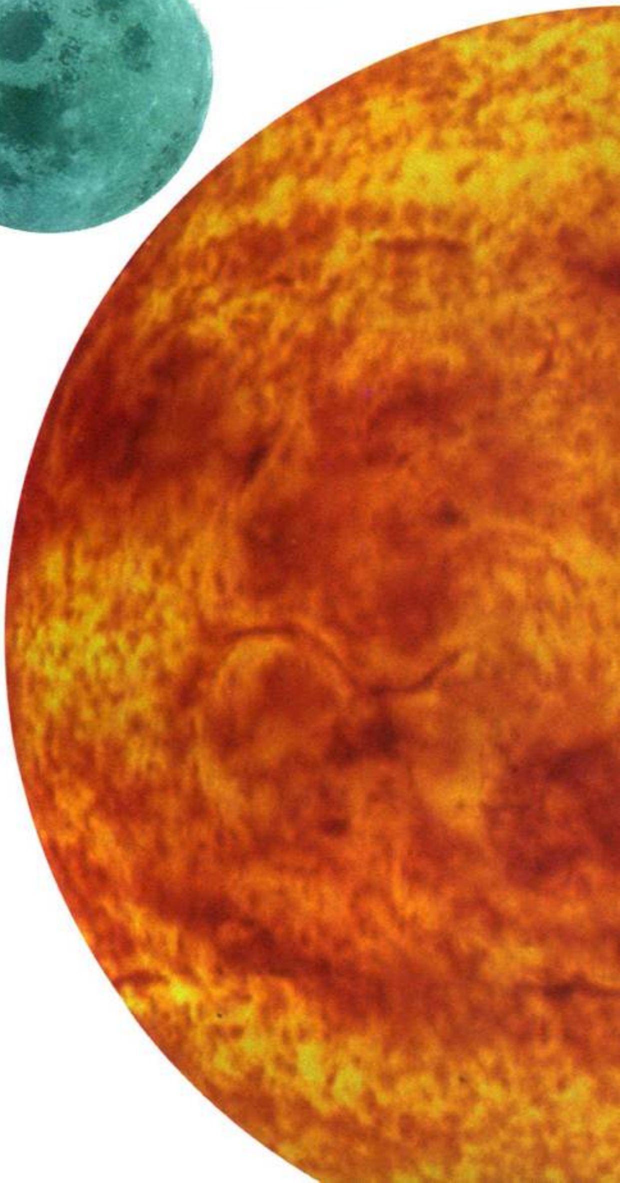
We have every reason to believe there are heaps of cosmic rubble at the Lagrangian points in Earth's orbit, 60 degrees ahead of and 60 behind the planet as it circuits the sun. These are places that for reasons best known to celestial mechanicians are gravitationally stable: Anything that gets there stays there. (Some see them as the source of raw materials already in space from which starships can be constructed.)

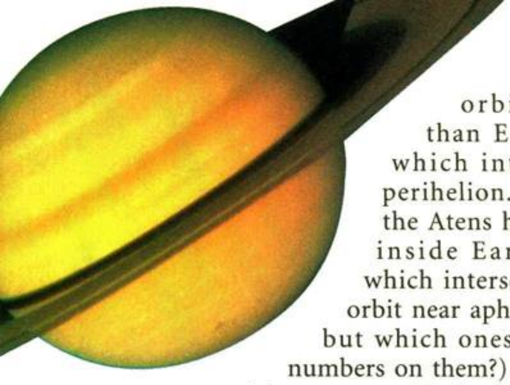
Some of our better meteor showers occur when the Earth plunges through bits and pieces strung out along the orbit of a comet that has volatized one too many times. Comets leave their own contrails in the sky, mostly ice grains but also a little grit and graphite and drops of hydrocarbons. Some ethereal fireworks for the patient.



Those grains of sand aren't the only things that cross our path. You've got pebbles, rocks, stones the size of bread boxes and Volkswagen Beetles and, well, mountains. Some of each are Earth-crossers, objects whose orbits intersect that of our home. We know of at least 1,500 mountains (a.k.a. asteroids) that do this; we don't know how many there are. (Some doubting Thomases believe that the sudden fuss about them is coming partly from military contractors, who are looking for new worlds — even little ones — to conquer.) Sooner or later one of these objects and Earth will arrive at the same place at the same time. Enough said.

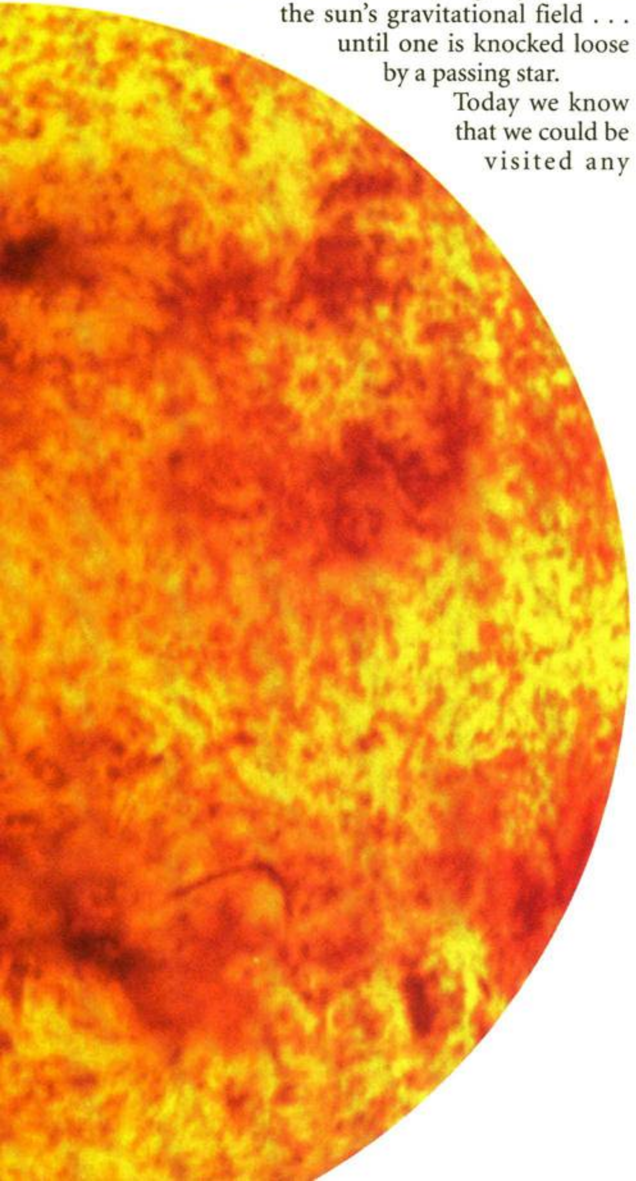
The Asteroid Belt, not included in most orreries, is as familiar to most as the planets. We know more than 4,000 of the asteroids by number, and there are innumerable smaller ones. Lots of asteroids, however, run around far from home. Trojan asteroids are those caught in Jupiter's Lagrangian points like insects trapped in a web. (Another Trojan trails Mars at one of its Lagrangian points.) The Centaurs are stuck in orbits between Jupiter and Saturn, a pale reflection of the Asteroid Belt, as is Chiron, a mystery that may have wandered in from the Kuiper Belt. Of more interest, perhaps, are those that come closer to home. The Apollo asteroids have

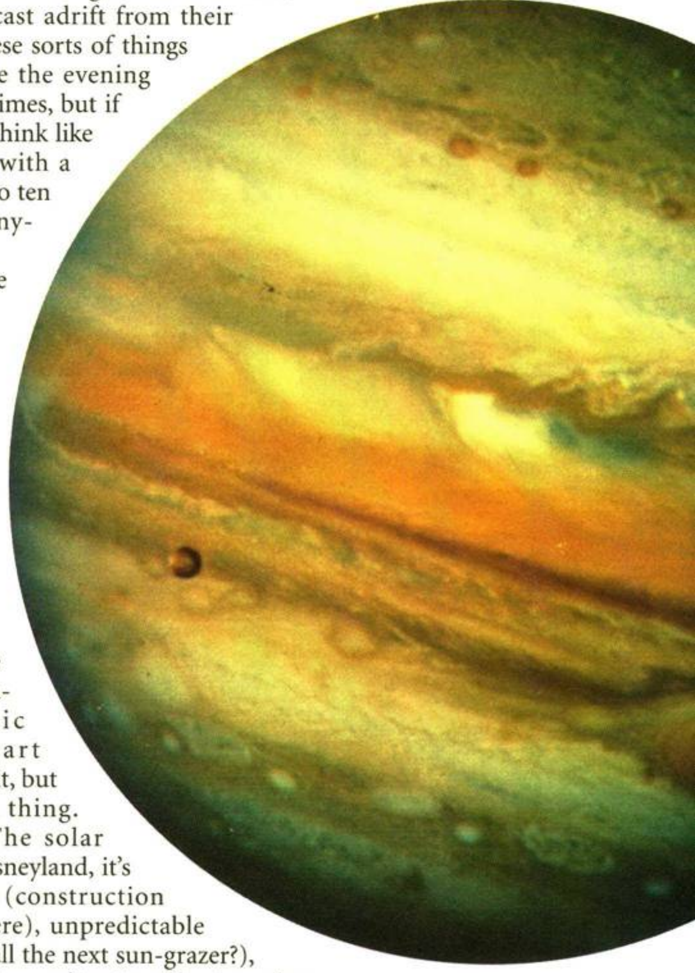




orbits larger than Earth's but which intersect at perihelion. A subset, the Atens have orbits inside Earth's, but which intersect Earth's orbit near aphelion. (Ah, but which ones have our numbers on them?) The Amor objects stay outside Earth's orbit, but not by much.

All the outer planets have rings of rubble, rocky roller derbies. Beyond the scope of orreries and astronomers of old are the interlopers barging in from the Kuiper Belt. Theory became fact in 1992, when the first object beyond Pluto — a block of ice a little less than 150 miles across, designated QB_1 — was photographed. Pluto itself may not be a planet at all in the sense that it formed with the other planets; instead it may be an immigrant from the belt. The same goes for its long time companion, Charon. In fact Triton, a moon of Neptune that runs its orbit backwards, might be a QB_1 sort of object. Beyond the belt lurk a trillion comets vaguely aware of the sun's gravitational field . . . until one is knocked loose by a passing star.





Today we know that we could be visited any time by planets flung out of their own systems and by underachieving stars known as brown dwarfs, cast adrift from their birth places. These sorts of things may never make the evening news in our lifetimes, but if we can learn to think like a solar system, with a life span of five to ten billion years, anything is possible.

So here we are. The solar system may be a little scruffy, but it's not so bad. We don't feel the neutrinos zipping through our bodies, the daughter particles from cosmic ray showers, the microwave radiation. Magnetic fields pull apart light, polarizing it, but we don't feel a thing. Not a thing. The solar system is not Disneyland, it's real life: messy (construction debris everywhere), unpredictable (who wants to call the next sun-grazer?), and chaotic (why can't asteroids stay where they belong?). Who'd want it any other way?

The time is not far off when telephone companies will offer sky reports as well as weather reports, and the former could go something like this: "The moon is approaching first quarter. Saturn is bright in the southeastern sky after sunset. Meteor rates, as always, will go up after midnight as the observer rotates around to the front side of the planet. Forty-mile-wide Xenia makes its closest approach at 11:09 p.m. eastern time when it will pass just 12 million miles away. The Shoemaker Near Earth Object Center reports nothing is expected to collide with Earth any time in the next 12 months. Comet Hilo-Cone is now a 4th-magnitude object in Ophiuchus as it speeds away from the sun, never to return. The second intruder from the Kuiper Belt this month has been announced by the International Sky Patrol."

Hey, you gotta live someplace. ■

John P. Wiley, Jr., likes nothing better than wrapping his neurons around cosmological ideas. But eye-level, "you are there" pictures of real worlds — the Pathfinder panorama of Mars, say — make him forget to breathe. He is science editor at Smithsonian *magazine.*

Outsmarting the

Chuck Steidel, one of the nation's top young astronomers, has pioneered a new way to study the distant universe.

by Marcia Bartusiak

As the afternoon shadows lengthen, puffs of clouds move down the mountain like ghostly apparitions. Ever so slowly, this cool autumnal day, the summit of Hawaii's Mauna Kea clears. And just in time.

Twelve minutes after nightfall, Charles Steidel directs one of the twin Keck telescopes to its first target, a deep field in the constellation Aquarius. Steidel is actually conducting his run remotely from the observatory's ranch-like headquarters, situated in the quaint town of Waimea lower down on the mountain. Steidel loves this set-up. He can fly in quickly from Caltech, where he is a professor, no longer losing time acclimating to a two-mile-high site. Known as Chuck to his friends, Steidel has a formal demeanor, polite and low-key. His clothes are casual, the requisite uniform for observing: green sweat-shirt and jeans. Tonight, he and his graduate student Kurt Adelberger are attempting to map the distribution of young galaxies in the early universe. They want to know how the galaxies congregate into giant clusters.

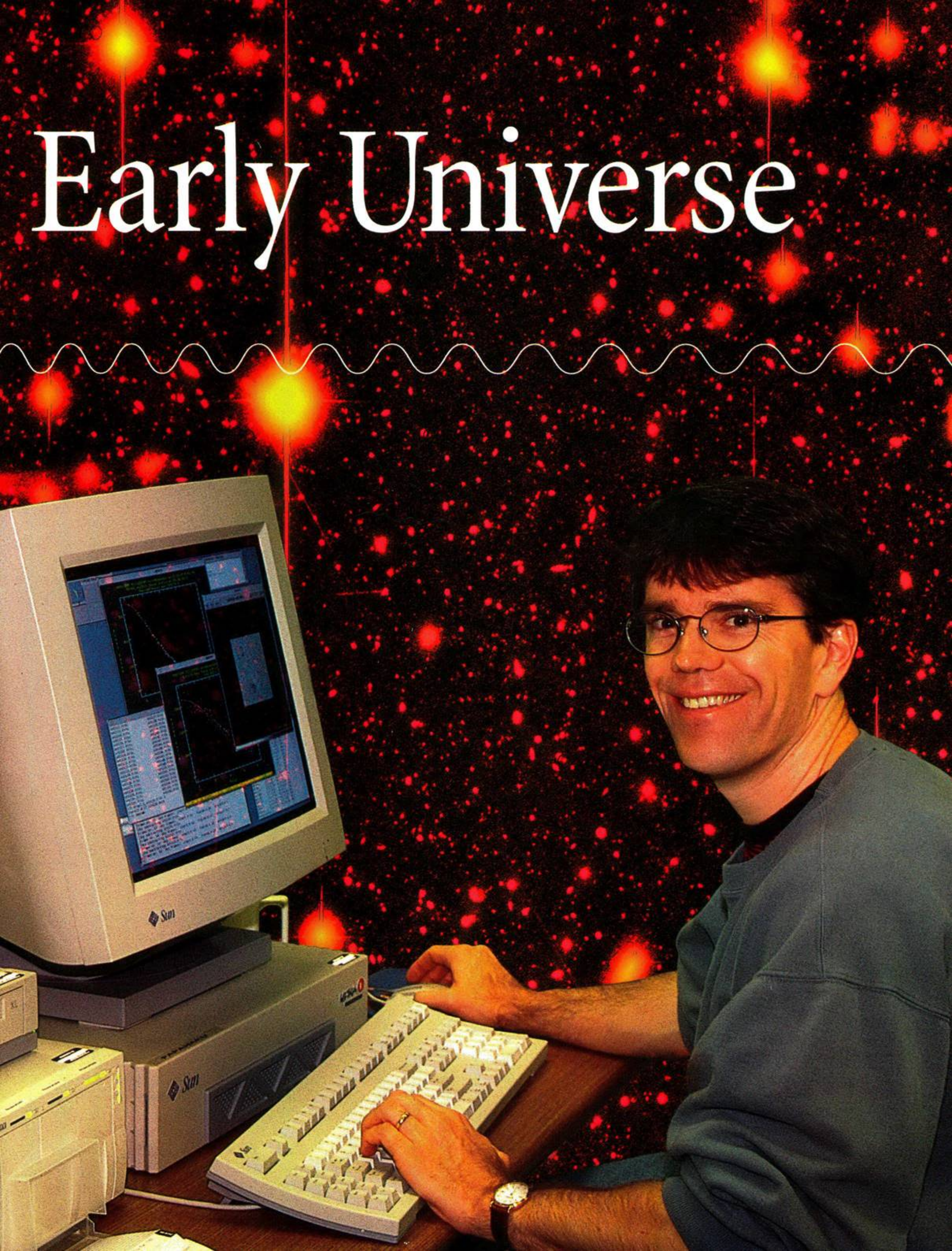
Just a decade ago the far universe was a dim mirage. Now, thanks to new technologies and clever strategies, astronomers are pushing outward billions of light-years, to nearly the edge of the visible universe and the beginning of time, given the amount of time it takes light to travel those great distances. Steidel's triumph in this endeavor was mastering a technique for detecting young galaxies. He might be called the Henry Ford of galaxy hunting: He began finding infant galaxies wholesale, in assembly-like fashion. "I think Chuck's work is one of the most important developments in observational astronomy in the last 10 or 20 years," says Caltech astronomer Wallace Sargent.

Sargent is not alone in his assessment. Last year the American Astronomical Society awarded Steidel the Helen B. Warner Prize, given annually to an astronomer no older than 36 who makes a significant contribution to the field. Looking over the list of past

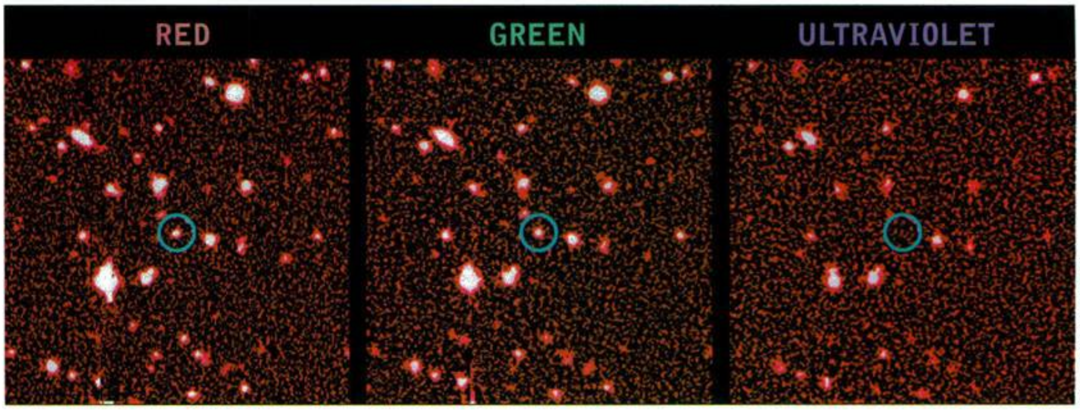
Chuck Steidel operates the giant Keck I Telescope from the Remote Operating Center.

Barbara Schaefer (W.M. Keck Observatory)

Early Universe



Chuck Steidel pioneered a method for finding galaxies more than 10 billion light-years away. Such galaxies will appear in both red and green light, but their ultraviolet light will be absorbed en route to Earth, rendering them invisible through an ultraviolet filter.



Chuck Steidel (Caltech)

winners, one sees a veritable who's who of astronomy, such as Margaret and Geoffrey Burbidge, who helped unravel how elements are made in stars, and Riccardo Giacconi, a founder of x-ray astronomy.

Steidel, in turn, is now fashioning a new history of the universe. All galaxies did not emerge in one great burst of fireworks as once thought. Rather, they seem to have arisen more like an ever-growing roaring fire. Steidel's work suggests that the largest galaxies, the ones destined to be the massive ellipticals and the bulges of major spirals like our own Milky Way galaxy, were in place fairly early, when the universe was less than a quarter of its present age. Such early births were a surprise to many. Star formation rates, though, seemed to have peaked later as smaller galaxies continued to coalesce, interact, and evolve over several more eons. Moreover, Steidel is also gathering hints that the universe's structure — the tendency for galaxies to align themselves into sheets and bubble-like walls — can be seen early on as well.

None of this information arrives quickly. "We do a lot of work before we ever get to the Keck," notes Steidel. First, pictures of the deep fields are taken with the 200-inch Hale Telescope on Palomar Mountain in California. Each picture, covering a region of the sky about the size of a quarter moon, contains some 3,500 objects, mostly stars and nearby galaxies. But some of the objects, usually around 100, look different. They could be young galaxies caught at the farthest edge of the visible universe.

To know for sure requires the power of the Keck. A set of "masks" is constructed before an observing run, each a rectangular plate of aluminum with a couple dozen narrow slits, much like the holes in an old computer punch card. Each slit has been carefully machined to align with a target galaxy, blocking out the rest of the field. Thus, with the mask in place at the focus, only the light from the target galaxies enters the telescope's spectrograph, which then separates the light into a rainbow of colors for analysis. In this way, observers can confirm the distances to many galaxies at once, not one at a time as in the old days. Distances are pegged by noting how much the light has been stretched and reddened ("redshifted" in astronomers' jargon) by the universe's expansion.

Years of experience allow Steidel to detect crucial spectral lines amidst the noise. Right off, he finds a galaxy at a redshift of 3.45. That number is a gauge of cosmic distance. The higher the redshift, the more distant the galaxy. A redshift of 1, for example, is roughly halfway back to the Big Bang. A galaxy at a redshift of 3, on the other hand, resides at a distance of about 10 billion light-years, when the universe was only one-sixth its current age. "It's great what you can do when the mask is in place," says Steidel.

STEIDEL DOESN'T FIT THE STEREOTYPE OF AN astronomer. As a child, he never gazed at the stars, never read science fiction, never watched *Star Trek*. He was born in Ithaca, New York, in 1962, when his parents were graduate students at Cornell University, his father studying material science, his mother English literature. The family, including a younger sister, eventually settled in Allentown, Pennsylvania, where Steidel grew up. He recalls a rather lonely childhood, spending a lot of time reading. He was interested in science, building the occasional model rocket, but he was also attracted to literature. The reclusive Thomas Pynchon is a favorite author, which is a telling clue about Steidel, a very private man. Pynchon's novels, dense and allegorical, often require a second reading. His latest book, *Mason & Dixon*, was reviewed as being "about the follies of the Age of Reason and the ... misguided imperatives of straight lines."

Steidel, too, dislikes answers arrived at straight-away, preferring problems that engage the mind and require interpretation. That's what attracted him to the distant universe. "I like the nebulous, the far away things where you get only glimpses," he says. "Many are starting to claim that we're about to find out all of cosmology's holy grails, such as the Hubble constant, the fate of the universe, as well as its size and age. But I'd be disappointed for the quest to be over. Just filling in the details is so much less interesting."

Indeed, upon entering Princeton University in 1980, he at first feared that adopting a science major would provide no more than vocational training, simply acquiring the tools of a trade. But he eventually learned that the astronomy department offered the opportunity to do research.

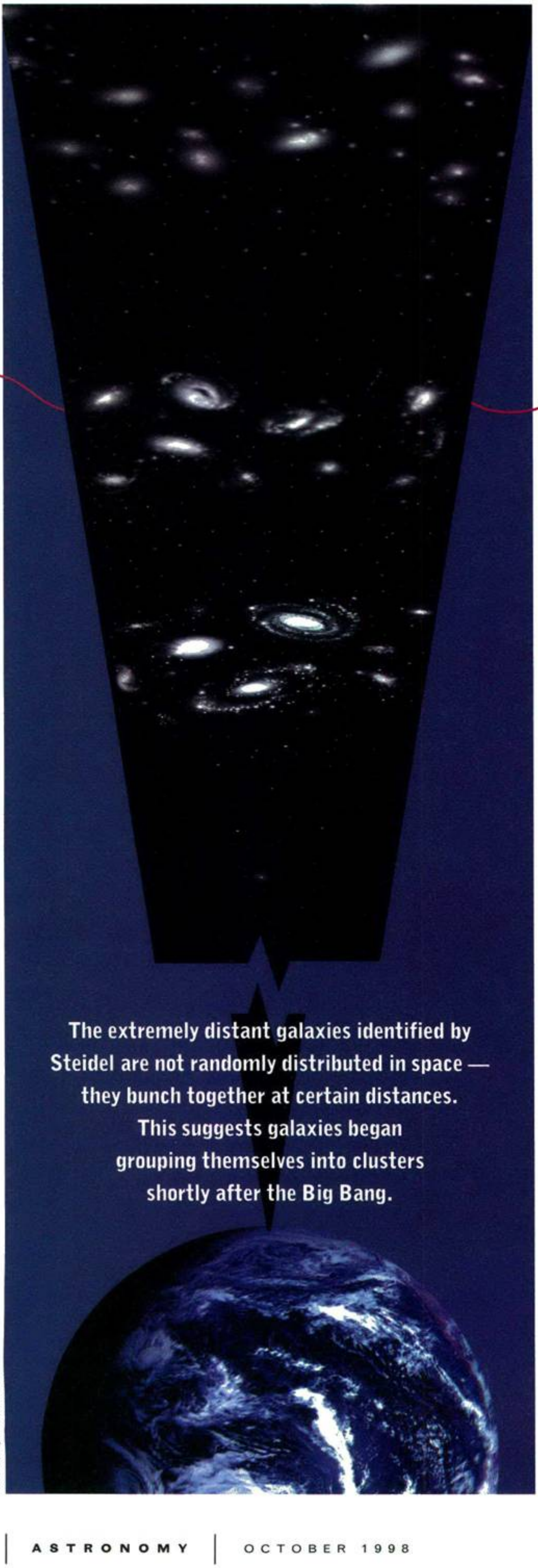
The shy teenager began to socialize by both organizing a band that played at college parties and working as a disk jockey at the campus radio station, where his taste in music ran from blues to alterative rock. That's where he first met Mark Dickinson, now an astronomer at Johns Hopkins University and one of Steidel's closest colleagues. "We shared a common interest in obscure garage bands of the sixties, the noisier the better. We tortured the New Jersey public," recalls Dickinson. Working from the basement control room over summer breaks, the two friends rarely saw sunlight for weeks at a time, surviving on beer and tuna fish sandwiches. "Not much different from astronomy in a way," notes Dickinson. Around this same time, Steidel also met his future wife Sarah, a history major, at one of Princeton's eating clubs.

While his social life was booming, he feared failure in his studies. His senior thesis put limits on identifying galaxies at great distances, work "reduced to rubble by Princeton's top faculty members, Jerry Ostriker, James Gunn, and Ed Turner. The worst experience I've ever had in astronomy," he says. But sheer inertia kept him in the game. Although theory is stressed at Princeton, he eventually chose Caltech, a haven for observers, for graduate school. "A visit to the 200-inch at Palomar in the spring of 1984 clinched it for me," he explains. "Keck is high-tech, but it has no personality like the 200-inch has. Palomar's dome has a classical beauty. It was then that I decided to be an observer."

Once at Caltech, he sought out Sargent to be his thesis advisor, a 33-year astronomy veteran known for his work at the far frontier. "He was the faculty member I found the most intimidating, and that attracted me," says Steidel. Sargent remembers it a bit differently: "At the start of a semester, each faculty member gives a talk to 'advertise their wares.' For mine, though, the students usually fall asleep. I took Chuck on because he was the only one who asked."

Steidel's research strongly suggests that major galaxies such as M81 formed when the universe was quite young.

Hale Observatories



The extremely distant galaxies identified by Steidel are not randomly distributed in space — they bunch together at certain distances. This suggests galaxies began grouping themselves into clusters shortly after the Big Bang.

Astronomy: Elisabeth Rowan

STEIDEL RECALLS HIS GRADUATE-SCHOOL DAYS WITH fondness. He married Sarah and developed a collegial relationship with Sargent, working on one of Sargent's specialties, quasar absorption lines. A quasar is believed to be an extraordinarily bright young galactic center powered by a supermassive black hole. As this distant beacon shines through the cosmos, some of its rays are selectively absorbed by intervening material, leaving distinctive lines in the quasar's spectrum. These absorption lines enable astronomers to examine the universe's evolution over billions of light-years. It is a means of gauging exactly when stars began cooking up carbon, oxygen, and other higher elements from the hydrogen and helium spewed from the Big Bang.

By the time Steidel completed his Ph.D. in 1989, he was determined to link those shadowy lines with specific entities, possibly newborn galaxies in the distant universe. To do this, he moved on to the University of California at Berkeley, a mecca for far-galaxy work, for four years of post-doctoral work. First-time fatherhood arrived as well, when daughter Emily was born in 1991.

At Berkeley, Steidel met back up with Dickinson. Still a graduate student, Dickinson was one of the few astronomers at the time who were attempting to detect faraway galaxies. Back then, their only hope to spy something in the distant universe was to look for extraordinary activity, which meant he and his colleagues ended up with a few radio galaxies here or unusually bright galaxies there. "But what did the average galaxy look like at those far distances?" asked Steidel when he arrived. Distant galaxies, so dim and obscure, simply got lost amidst the crowded celestial sky.

Using telescopes at both Lick Observatory in California and Kitt Peak National Observatory in Arizona, Steidel and Dickinson took deep exposures of the sky around selected quasars. After perusing the images and picking out any faint galaxy-like objects near quasars, they'd go back to the telescope to laboriously take spectra of each and every one. In this way, they found some 70 normal, run-of-the-mill galaxies out to a redshift of 1, some 6 billion to 7 billion light-years distant.

Working with others, Steidel decided to go out even farther, which was quite a challenge. How could he pick out fainter and fainter baby galaxies? There was a trick: Newborn galaxies are awash in hydrogen gas, which absorbs much of the ultraviolet radiation generated by its many young stars. The galaxy freely emits its red, yellow, and green light but holds on to its ultraviolet radiation. It never gets out. This effect is known as the ultraviolet dropout. This means such a far galaxy could be seen through a red filter, as well as a green, but would disappear when observed through an ultraviolet filter.

In 1991, using the 4-meter Cerro-Tololo Inter-American Observatory telescope in Chile, Steidel and his colleagues examined a far quasar with three different filters to see if it had any close companions. They found more than a dozen fuzzy blobs that fit the bill: All vanished in the ultraviolet, which suggested they were fairly far-off. "But just finding the dropouts didn't set people on fire," notes Dickinson.

What Steidel needed were spectra, which would determine the distances exactly. And the only telescope on Earth that could do that was the Keck. After a brief professorship at MIT, Steidel moved to Caltech so he would have regular access to the giant instrument. His breakthrough came in the fall of 1995, just a month after his return to the West Coast. Going out to Keck with Dickinson for two nights of observing, Steidel came home with 15 galaxies past a redshift of 3. "And that was 15 more than astronomers had at the time," notes Steidel. People had even been speculating that average galaxies wouldn't be found at that distance, but that hypothesis was quickly demolished. "Everywhere you looked in the sky, there were tons of these things," says Dickinson.

In his usual self-deprecating fashion, Steidel credits his success to sheer luck. That did play a role: He was in the right place, at the right time, using the right instrument for the problem at hand. But as the famed French chemist Louis Pasteur long ago noted, "In fields of observation, chance favors only the mind that is prepared." Steidel's discovery was the culmination of a well-conceived program. He had taken a technique and applied it across the heavens. He enabled astronomers to begin strip-mining the far universe.

"His accomplishment is all the more miraculous because in April 1996, Sarah gave birth to twins three months premature," points out Sargent. For nearly three months, in the midst of analyzing his blizzard of data, he spent half of his time helping care for his wife and children, until the twins could be safely released from the hospital. (Nicholas and Elizabeth are now healthy and energetic toddlers.)

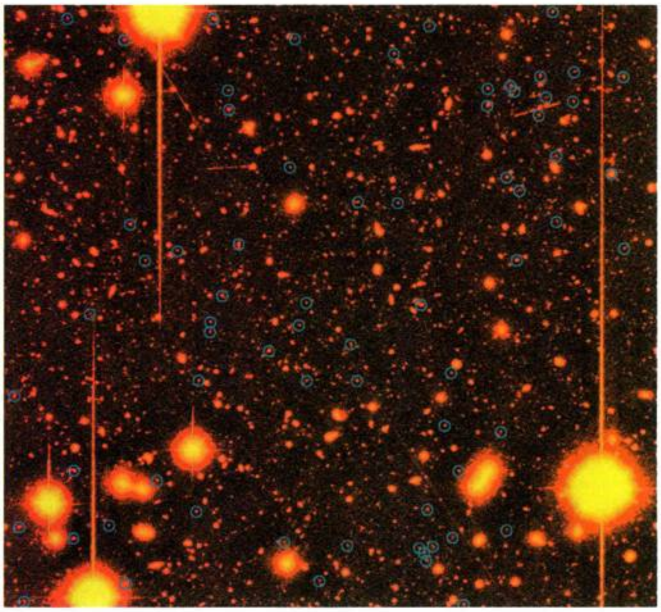
AT FIRST, JUST FINDING THESE YOUNG GALAXIES WAS an end in itself. But now, Steidel has built up quite a large catalog of distant galaxies. He and his colleagues have found more than 600 already and have well over 1,500 candidates awaiting confirmation. With such a large sample in hand, they can begin to answer questions about the cosmology of the early universe. How many of these galaxies are there? When did they form? How are they clustered? Just setting a record for finding the most distant galaxy doesn't interest Steidel. "We're not after a *Guinness Book* world record," he stresses. "There's a difference between making headlines and advancing our knowledge."

What have they found out so far? For one, these young galaxies are not rare. In fact, the population of objects in that far sector of the universe just about matches the population of bright galaxies — the Milky Way and its kin — that exists today. That seems to suggest that they are the initial cores of ellipticals, as well as the bulges of yet-to-be spirals. What is more surprising is the clustering found in this early cosmic era. In one field, Steidel and his colleagues have observed a collection that resembles one of the great walls of galaxies spread out like a vast maze in the present-day universe. It might be that they are finding the first galaxies that formed in slightly overdense regions, islands with a touch of extra mass in the smooth material spread over space from the Big Bang.

Halfway through the night, Adelberger brings up a rough cut of the data on his computer monitor, a series of spectrums lined up, from top to bottom, like the ribbons on a highly decorated soldier. In one, he spots a bright line, a typical emission line from energized hydrogen, but shifted quite a bit from its regular position. "That looks promising," says Steidel, bending over the display. A quick calculation pegs it at a redshift of 4.2, that's farther than a record-setting distant quasar Steidel helped find just a decade ago.

By 4:20 a.m., with about an hour left of usable telescope time, Steidel announces that he has "hit the doldrums." He's gone 30 hours without sleep. He had to get up quite early the previous day to fly from Los Angeles to the Big Island in time to set up his observing run. On a scale of 1 to 10, Steidel gives the night a 3.

During the second night a fog settles over the mountain, which cuts off their view. As the hours progress, it's catch as catch can as the moisture comes and goes. "Isn't it a ridiculous science that puts you at the mercy of the weather?" says Steidel.


Chuck Steidel (Caltech)

In this image taken with the 5-meter Hale Telescope on Palomar Mountain, the circled galaxies disappear in ultraviolet light — indicating they are very far away. Steidel later takes their spectra with the 10-meter Keck Telescope to determine their redshifts, which yields their distances.

It is the third night that's the charm. The run moves along like clockwork (well, at least for the first half of the night, before a fog rolls in). "This is more typical of what I usually get at Keck," says Steidel. In the end, they were able to determine some 80 redshifts, half the number they hoped for.

But then, Pynchon-like, Steidel is not expecting definitive answers anytime soon. He suspects that nature will prove to be more complicated than the optimists believe. "I'm not pursuing 'truth,'" he says. "The interesting part is the process. Who wants to get rid of the mystery?"

Award-winning science writer Marcia Bartusiak is a member of Astronomy's *editorial advisory board. Her previous article was "A Beast in the Core" in the July 1998 issue.*

Blowin' in the Solar Wind

Scientists are using the latest satellites and supercomputers to predict the onslaught of space storms.

by Adam Frank

It begins on the sun's surface: a hellish plain of boiling 10,000° F gas. Powerful magnetic fields curve high into the solar atmosphere to form giant, twisting arcs of energy. Matter streams up these arcs to be gripped in a magnetic vise hundreds of thousands of miles above the surface.

Then something happens. Magnetic lines of force snap. A billion tons of solar gas are suddenly blown outward, exploding across interplanetary space. Three days later, the shimmering ball of energy smashes head-on into an unsuspecting Earth.

In low-Earth orbit, astronauts building the International Space Station are caught unprotected in the torrent of harmful high-energy particles. Orbiting satellites also feel the blow as the particles destroy solar panels and sensitive electronics. As the satellites fail, global lines of communication fall into silence. The particles continue downward, forming a vast sheet of atmospheric current that overloads sprawling power-line grids miles below. Without warning, millions of people are plunged into darkness.

This is not the plot of a cheesy disaster movie; it's a description of nasty space weather. Space weather is a new term in the lexicon of science that refers to surges of matter and magnetic energy blown off the sun that periodically sweep across interplanetary space.

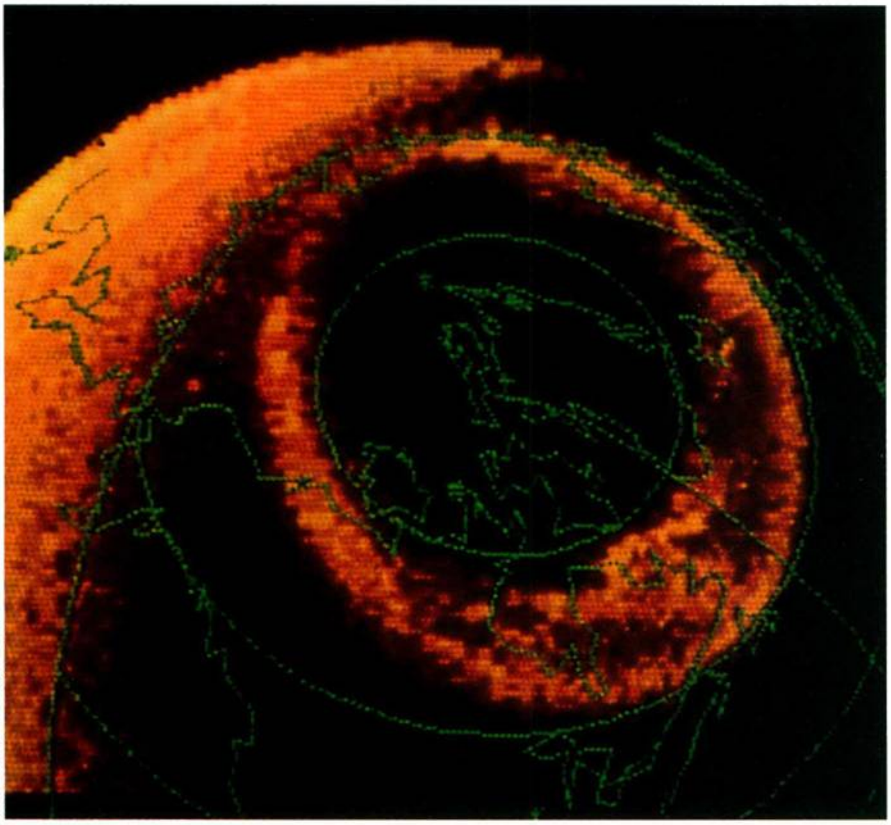
While Earth's atmosphere and magnetic field shield humans from direct danger, space weather's effect on our technological society can be devastating. A particularly severe space storm slammed into Earth on March 13, 1989, causing a system-wide power failure in Quebec. Just 90 seconds after the onset of the storm, six million people were left without power during an outage that cost hundreds of millions of dollars.

Without the shield of Earth's atmosphere, satellites are particularly vulnerable to space weather. "We have all this new technology that uses satellites: cellular phones, global positioning systems, internet commerce. These are all at risk from space weather," warns Joseph Davila of NASA's Goddard Space Flight Center.

Much of the new technology was put into place during the mid-1990s — the last quiet period of the 11-year solar cycle. "As the sun moves into its active phase in the years 2000 and 2001, we can expect more space weather and more severe space weather," says Davila. "We don't know how it is going to affect us."

Recognizing our vulnerability, NASA, the National Science Foundation, and several other U.S. government agencies

Prominences can stretch hundreds of thousands of miles above the solar surface. They act as "seeds" for coronal mass ejections. National Solar Observatory/Sacramento Peak



Louis Frank (University of Iowa)

This aurora was imaged in 1981 by the Dynamics Explorer-1 satellite. During severe space weather, aurorae can be seen at lower latitudes than normal.

have initiated a $100-million-per-year program to predict space weather. Knowing when a severe storm is coming should allow time to prepare. But prediction requires understanding, and it is this first step which scientists are struggling with. They must create a science of space weather — a task epic in its proportions.

To understand space weather, researchers must first learn how titanic bubbles of hot gas and magnetism get blown off the sun, events called coronal mass ejections. Then they must flesh out the physics guiding the nascent storm on its multimillion-mile journey to Earth. Finally they must fathom what happens when the hyperenergetic mass collides with Earth's magnetic field. Each facet of the problem is worth a library of Ph.D. theses. Fitting them together into a coherent whole requires tools so powerful they are a step beyond what was the cutting edge less than a decade ago.

As these tools have become available to scientists in the last few years, progress has been swift and startling. Davila is part of a team using state-of-the-art "parallel" supercomputers to model the physics of magnetism and matter on the solar surface. MHD calculations can take weeks or even months on normal computers. Parallel machines speed the process by taking one calculation and distributing it across hundreds of computer processors. Such cutting-edge silicon machinery is just about the only way to "see" into coronal mass ejection origins.

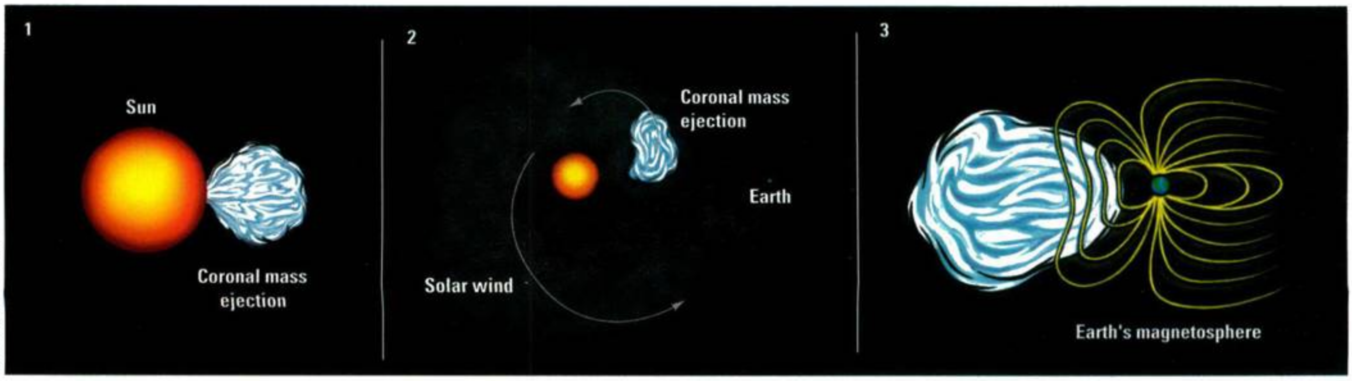
Computers are only half the equation though. Satellites such as the Solar and Heliospheric Observatory (SOHO) are revolutionizing our view of coronal mass ejections and space weather. SOHO is not orbiting Earth; it's at the Lagrangian 1 point, a place where Earth's and the sun's gravity exactly cancel out. From this vantage point, Earth never blocks the view, so the spacecraft's advanced instruments can observe the sun round the clock. "That could never happen with a satellite in Earth orbit," says Art Poland, SOHO project manager.

SOHO's instruments also let researchers see much farther out from the sun than was possible before. The last generation of satellites couldn't see beyond about eight solar radii (3.5 million miles). SOHO can see out to 30 solar radii. "We can now watch coronal mass ejections as they form and head out into space," says Poland. Together, advanced supercomputer simulations and SOHO are bringing the dream of space weather prediction down to Earth. (Communications have recently been lost with SOHO, see "SOHO, Phone Home," page 24.)

Unleashing the Storm

The sun is always making space weather. Usually it takes the form of the solar wind, a generally steady flow of charged particles (mostly protons and electrons) that scientists have known about for 50 years. When

Space weather occurs when the sun belches out a coronal mass ejection (1), which plows through interplanetary space (2) and smashes into Earth's magnetosphere (3).



Astronomy: Terri Field

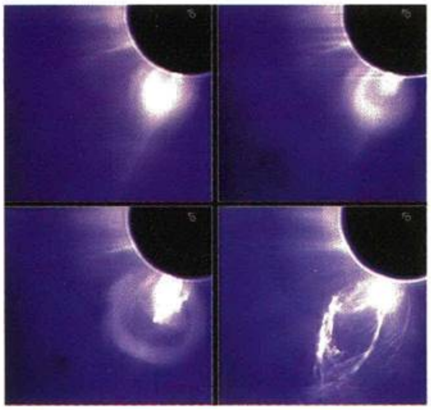
solar-wind-charged particles slam into molecules in Earth's upper atmosphere, the interaction helps generate aurorae. The bad weather, however, almost always begins with coronal mass ejections. The power unleashed in a coronal mass ejection is staggering. Each one launches billions of tons of matter into space with an energy equivalent to 100 million atomic bombs. The first step in understanding space weather is understanding what creates coronal mass ejections.

While the details remain shrouded in mystery, space scientists know that coronal mass ejections are driven by the sun's magnetic field, which is several thousand times more powerful than Earth's. Volatile magnetic fields thread the outer solar layers and extend high into the corona. As Davila says, "The sun's magnetic field is constantly evolving. There is always fresh magnetic energy appearing at the sun's surface from deeper layers where it's created. Old magnetic structures are constantly being blown into space. We're pretty sure the release of coronal mass ejections is part of this magnetic evolution."

To build a working theory of coronal mass ejections, scientists must plunge headfirst into the study of magnetized fluids, a mathematically beautiful but maddeningly complex field known as Magneto-Hydrodynamics (MHD). The usual tricks physicist like to play with hard equations become all but impossible with MHD.

Despite the difficulties, scientists do have a good candidate for the "seeds" of coronal mass ejections: prominences. Solar prominences are vast arcs of hot, magnetic gas that extend hundreds of thousands of miles into the corona. They are bound to the sun at anchor points, where the arcs dive below the surface.

Once a prominence forms it can last for an hour or more. Researchers believe that prominences can become coronal mass ejections when the anchor points at the surface are spliced in a process called "magnetic reconnection." When reconnection occurs, magnetic field lines snap like over-strained wires. Freed from their chains to the sun, the prominence's powerful fields and super-heated gas explode outward into space — a coronal mass ejection. "We don't really understand the process of reconnection yet," says Davila, "but we do know it must happen to make coronal mass ejections." "What we don't understand is why coronal mass ejections happen so suddenly," adds Spiro Antiochos of the Naval Research Laboratory. "Somehow the magnetic fields establish a "lid" for gas in the corona, but then that lid has to come off — fast!"



This time sequence shows a coronal mass ejection exploding outward from the sun. These events occur about once every Earth day.

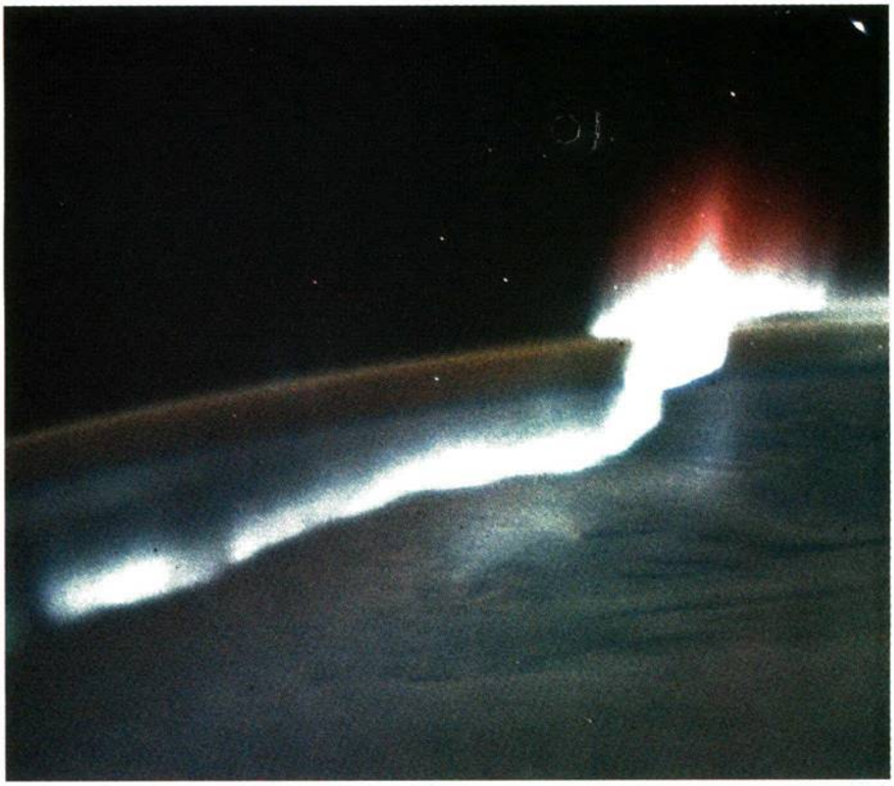
HAO/NCAR and NASA

Crossing to Disaster

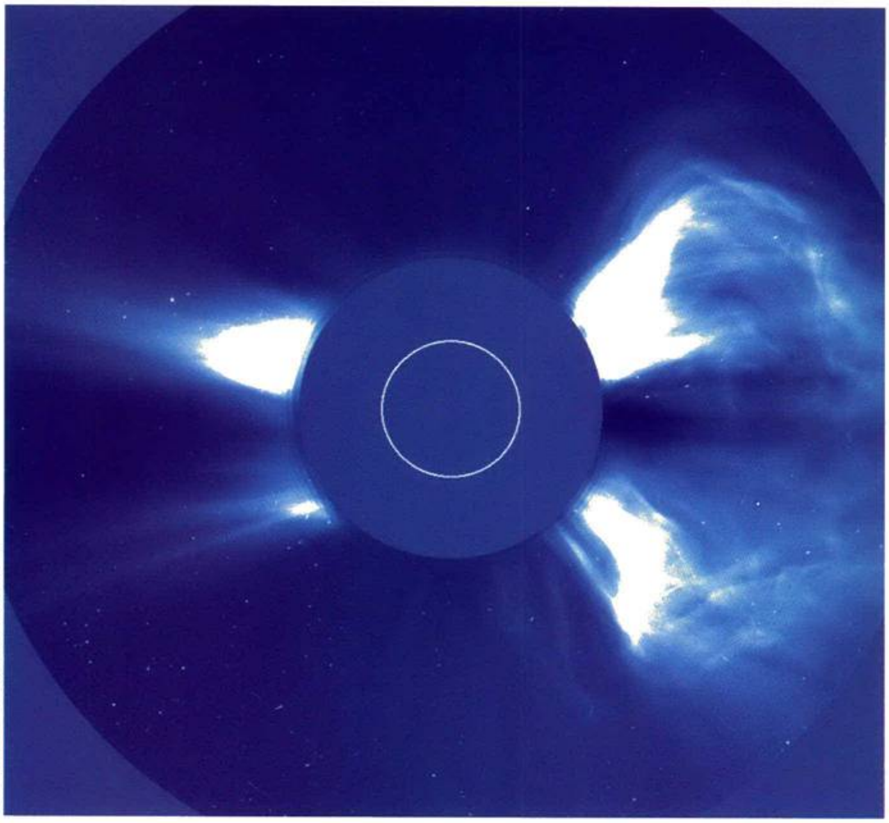
Once a coronal mass ejection is seen exploding off the sun, what determines if it hits Earth? This is the $64,000 question for space-weather forecasters. Isn't finding earthbound coronal mass ejections as simple as identifying the ones pointed at Earth when they form? According to Tamas Gombosi of the University of Michigan, the answer is no. Gombosi is the team leader for an ambitious project that is trying to simulate the entire evolution of coronal mass ejections. Gombosi's team wants to follow one from the sun all the way to Earth, including its interaction with Earth's magnetic field. As Gombosi puts it, predicting which coronal mass ejections are earthbound is a little like trying to target the head of a pin with a cannon from a distance of 10 miles. Earth is located 93,000,000 miles (150,000,000 km) from the sun, yet this target is only 7,926 miles (12,756 km) wide. "Given the disparities in the size scales," says Gombosi, "it's very easy to miss."

To make matters worse, the coronal mass ejection is not like a cannonball that only explodes when it lands. "Once the coronal mass ejection leaves the sun," Gombosi explains, "it's already exploding. The ejection is a hot blob of gas that is rapidly expanding and changing as it propagates through interplanetary space."

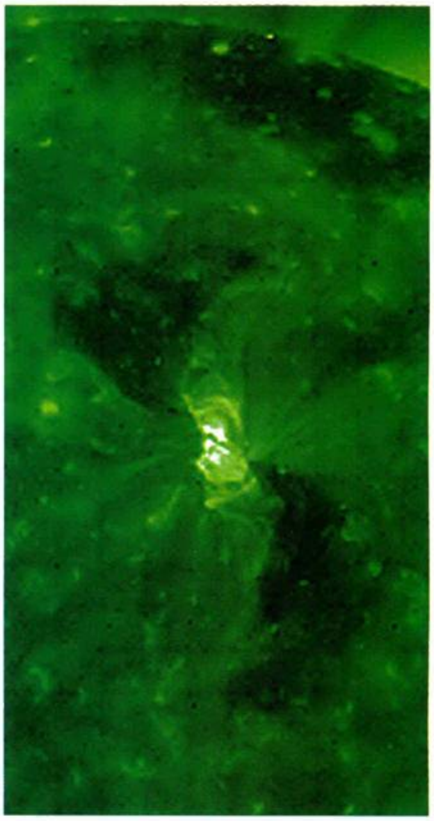
Space shuttle astronauts photographed this aurora in 1985. Aurorae occur throughout the solar cycle, whereas severe space weather occurs near solar maximum.



NASA



SOHO/LASCO Consortium and NASA/ESA



SOHO/EIT Consortium and NASA/ESA

The most severe space weather originates from vast outbursts on the sun called coronal mass ejections, seen in profile by the SOHO spacecraft's LASCO instrument (left) and face-on by the EIT instrument (right).

The solar wind makes tracking the coronal mass ejection's trajectory even more difficult. The solar wind generally moves slower than coronal mass ejections. That means the exploding plasma blob must plow through the wind on its way toward Earth. The solar wind has a magnetic field in it too, so scientists must once again wrestle the physics of MHD into submission.

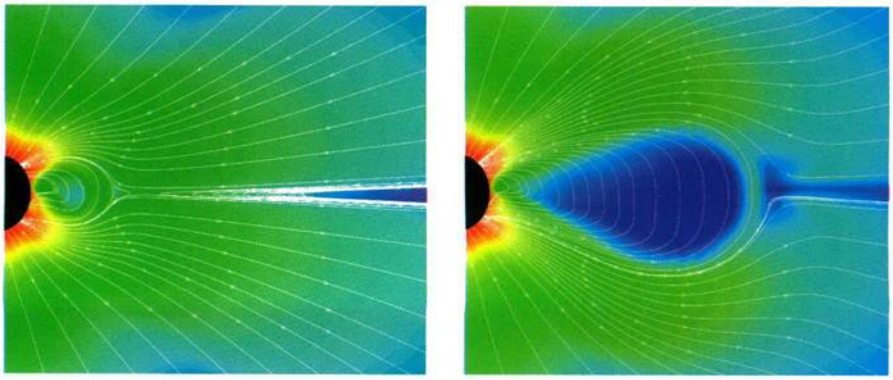
The orientation of the fields is also critical. As the coronal mass ejection heads toward Earth, its magnetic field pushes against the solar wind's field. If you've ever played with toy magnets, you know it takes effort to squeeze two of them together if their poles are aligned. Flip them and they stick together quite happily. Magnetic fields attract or repel each other depending on their relative orientation. As the coronal mass ejection drives through the solar wind, it feels magnetic pushes and pulls, which depend on the two fields' alignments. These forces can make tracking a coronal mass ejection trajectory extraordinarily difficult, even with a supercomputer.

Some coronal mass ejections, of course, get through. According to Davila, we get hit about once every 12 days. That may seem like a lot, but every collision between Earth and a coronal mass ejection does not produce a major space storm. To predict which coronal mass ejections make for bad space weather, you must know if the collision will be a head-on or a glancing blow, and once again, the orientation of the ejection's magnetic field is all-important.

The Protective Shield

Earth's magnetic field originates in swirling currents of molten iron deep in the core and extends more than 20 Earth radii (40,000 miles) into space. This "magnetosphere" is our principle means of defense against all forms of space weather, including the normal solar wind. As high-speed solar wind particles flow toward Earth, the magnetosphere acts like an extended cushion. A magnetic "bow shock" forms ahead of Earth in the sunward direction, like the bow wave ahead of a moving ship. Charged solar wind particles are deflected by this bow shock, flowing harmlessly around and past Earth.

A coronal mass ejection represents a major challenge for the magnetospheric shield. The massive onslaught of solar gas beats the terrestrial field



A supercomputer models the evolution of a coronal mass ejection as it surges away from the sun. Tamas Gombosi, Darren DeZeeuw, et al., (University of Michigan) down toward lower altitudes the way an umbrella is collapsed by a strong gust of wind. The magnetosphere absorbs the coronal mass ejection's energy and acts like a tightly wound spring. If all that energy is released too quickly, it can spell disaster for the whole near-Earth environment.

If the coronal mass ejection's magnetic field is oriented in the same direction as Earth's south-to-north field, the two fields repel and the magnetosphere will be able to bear the brunt of the collision and then bounce back slowly. If, on the other hand, the coronal mass ejection has a southward directed field, the oppositely-oriented fields annihilate each other and Earth is left without its protective magnetic cushion. The pent-up energy released in the annihilation blows charged particles such as protons and electrons to extreme velocities. It's these high-speed particles flooding Earth's local space environment that cause most of the damage in a space storm and occasionally generate spectacular aurorae at much lower latitudes than normal.

Only after the coronal mass ejection passes can the magnetosphere re-expand and recover. The entire process from the advent of the storm to recovery can take hours. Without proper warning to protect humans and equipment, that can end up being a very long time.

Charting the Waters

With new SOHO data and supercomputer models, researchers can now see deeper into the physics of space weather. Does that mean we will soon be able to predict when and where a coronal mass ejection is going to occur? "Not likely," says Davila. "We may be able to say where on the sun they are more likely to form, but just like the weather on Earth, we may never be able to say exactly when a storm is going to start."

The onus then falls to forecasting which coronal mass ejections are dangerous. According to Gombosi, once a coronal mass ejection is seen erupting on the sun, a real space weather forecasting system would need 15 hours to make a prediction. The time is spent preparing and running the supercomputer simulations and then analyzing the huge amounts of generated 3-D data. "Fifteen hours is not too bad, really," says Gombosi. "We would still be two days ahead of the coronal mass ejection." If the prediction points to bad weather, then the early warning would allow power companies, satellite operators, and space-walking astronauts to hunker down and wait out the storm.

While sophisticated forecasting systems are likely to be in place in the next few years, our battle with space weather is only just beginning. Most people still imagine interplanetary space as a great void. But as space becomes the terrain where mundane forms of human activity such as commerce are played out, that attitude will have to change. Our growing familiarity with the space environment has pushed us to first recognize and now confront that this so-called void is far more like the sea than even poets might have dreamed. Coming to terms with space weather is not just a technical issue, it's part of our becoming a spacefaring civilization. After all, if we want to sail, we're going to have to deal with the winds. ■

Adam Frank is an astrophysicist at the University of Rochester. His previous feature article for Astronomy *was "Crack in the Clockwork" in the May 1998 issue.*

Aurorae are gentle manifestations of space weather that rarely cause problems. More severe space storms damage satellites, disrupt communications, and induce power outages.

Lauri Mala

REFRACTORS *by* CELESTRON®

Looking for a Refractor Telescope? — Look into Celestron!
. . . A Winning Combination

- **SUPER** Quality
- **SUPER** Performance

- **SUPER** Choices
- **SUPER** Prices

#21055-DX-AL

#21070

#21080

#21016

• Sturdy Equatorial and Altazimuth Mounts • Sizes Range from 60mm (2.4") through 102mm (4")

With over 20 models to choose from, there is sure to be one that matches your requirements.

The 60mm (2.4") refractor is the most popular telescope size for beginning astronomy enthusiasts and for casual gift-giving. This size telescope is perfect for introducing newcomers to astronomy, at an affordable price.

For astronomical observing, the 60mm refractor allows you to see lunar details, Saturn and its rings, Jupiter and its moons, the phases of Venus, larger globular clusters, bright double stars and some bright nebulae. After adding an optional solar filter, you can observe activity on the sun. In addition, a 60mm telescope can be used for terrestrial viewing, bringing the world closer to you and allowing you to observe wildlife, distant views and your environment.

The 70mm (2.8") models serve the beginner to intermediate observer who wants slightly more aperture than the 60mm models and allows you to see more detail on objects. These refractors deliver images 37% brighter than those produced by a 60mm refractor telescope. The achromatic optics are made to Celestron's exacting specifications and are quite excellent.

Celestron's 80mm (3.1") telescope models are top choices for serious beginning observers who want to start with a more powerful telescope and for intermediate level astronomers. These instruments perform equally well for viewing within our solar system and for deep-sky observing. Starting with a more powerful telescope can be a good option when you're looking for an instrument to grow with as you explore the hobby of astronomy.

The 102mm (4") models are carefully designed for the more serious astronomer and terrestrial observer and feature exquisite optics and precision, heavy duty mounts.

The optics of these telescopes are made to exacting standards, with high quality materials to ensure top performance. You'll find that astronomical viewing is a delight with these large, powerful 4" telescopes. They offer a 63% increase in image brightness over 80mm models, with the larger aperture delivering incredible images of: the moon; Saturn and its ring structure; Jupiter and its belts; and hundreds of deep-sky objects, including faint galaxies, nebulae and star clusters.

- All 70mm, 80mm and 102mm Models have Fully Multicoated Optics
- 80mm and 102mm Models are available on the new CG-4 mount, the most rigid German equatorial mount in its price range.

CELESTRON®

For full details on the complete line of Celestron Refractors and the wide assortment of accessories available, contact a Celestron dealer, Celestron or visit our web site.

WEB site at http://www.celestron.com

Celestron International • 2835 Columbia Street, Torrance, CA 90503 • (310) 328-9560 • FAX (310) 212-5835

CELESTRON® NEW STAR HOPPER® DOBS

UNIQUE STYLING and FEATURES

LARGEST RANGE OF APERTURES 4½" to 17½"

11" f/4.5
6" f/8
17½" f/4.1
14" f/4.5
8" f/6
4½" f/8
STAR HOPPER

The 6" to 17½" STAR HOPPERS have these Standard Features:

- Precision annealed Pyrex primary mirrors – better than glass used by competitors, ensure faster temperature stabilization and the highest quality steady optical figure.
- 25mm SMA Wide Angle Eyepiece – 1¼"
- 1¼" Rack and Pinion Focuser – 6" and 8"
- 2" Helical Focuser with 1¼" adapter – 11", 14", 17½"
- Premium Quality, Affordably Priced
- Optics are diffraction limited.
- Multi-Coated Primary Mirrors
- 6" and 8" have a Unique Balance System.
- Teflon and Nylon surfaces guarantee smooth performing mechanics.
- Collimation Tool – very useful and unique to Celestron
- **Made in the U.S.A.**

The 4½" Star Hopper

comes standard with a 5x24 Finderscope, 1¼" Rack and Pinion Focuser, 25mm SMA Wide Angle Eyepiece – 1¼", and it comes Fully Assembled and ready to use.

SPECIAL OFFER ON ACCESSORY PACKAGES:

- ● Three different very economical packages.
- ● Buy packages from your Celestron dealer at your convenience – no time restriction.
- ● See your Celestron dealer or distributor for details on how to order.

PACKAGE A

✔ Includes a 10mm SMA Wide Angle Eyepiece – 1¼" Moon Filter – 1¼", 5x24 Finderscope with bracket, CD-Rom "The Sky for Celestron"

PACKAGE B

✔ Includes a 10mm SMA Wide Angle Eyepiece – 1¼" Moon Filter – 1¼", 6x30 Finderscope with bracket, LED Flashlight, Celestron Deluxe Sky Maps.

PACKAGE C

✔ Includes a 7.5mm Multi-Coated Plössl Eyepiece – 1¼", 17mm Multi-Coated Plössl Eyepiece – 1¼", 9x50 Finderscope with bracket, Night Vision Dual LED Flashlight, CD-Rom "The Sky for Celestron"

DROP SHIP ANY STAR HOPPER

from the Factory to anywhere in the U.S.A. (48 contiguous states). Pay only the exact shipping charges (freight collect) with **NO** extra handling or packing fees.

See your Distributor or Dealer about delivery in Alaska, Hawaii or other Countries.

CELESTRON® *For more detailed information on these telescopes, contact a Celestron dealer or Celestron. Visit our Web site at http://www.celestron.com*

Celestron International • 2835 Columbia Street, Torrance, CA 90503 • (310) 328-9560 • FAX (310) 212-5835

THE SKY SHOW

A retinue of bright planets punctuates the dark autumn skies, while two meteor showers send streaks of burning particles to enliven the show. by Martin Ratcliffe and Alister Ling

▶ This month's October 5 harvest moon hangs like a glowing Chinese lantern in the eastern sky. For a few days, its bright yellow face rises 20 to 30 minutes later each night. This allows farmers to harvest their crops well into the evening — their tasks illuminated by soft moonlight. Normally the moon rises roughly 50 minutes later each night. It currently is in Pisces the Fish — in a region of the ecliptic that makes a small angle with the horizon. This allows the moon to command the evening sky for the first 10 days of the month.

October opens with a gibbous moon in Capricornus the Sea Goat and moves to the southwest of Jupiter on October 3. Shortly after midnight, the moon occults the minor planet Pallas for observers in the extreme northwestern United States and Canada. Though the 8.2-magnitude asteroid will be overpowered by the almost full moon, a high power eyepiece with a small field of view will reduce the moon's glare and help in detecting the asteroid. The moon meets Saturn one day after it is full and can be found just 2° south-southeast of the planet on October 6.

A challenging daylight occultation of Aldebaran occurs on October 9 and is visible to those in the western half of the United States. The occultation occurs shortly after 9:30 a.m. Pacific Daylight Time and varies slightly with geographic location. Though the moon does act as a guide to the star, it is a good idea to set your equatorially-mounted telescope to track Aldebaran before dawn. This will make the star easy to find during the daylight hours.

After traversing Taurus and Gemini, the last-quarter moon rises after midnight on October 12. This leaves only the planets to brighten the darkness of the evening sky. The birds of summer, Aquila

These pinwheels and planets were captured when the moon, Venus, and Jupiter gathered above the southeastern horizon on the morning of April 23, 1998. The photo was taken from the grounds of College Boreal in Sudbury, Ontario.

Mark Oldfield

OCTOBER 1998

1 The moon passes 3° north of Uranus, 8 a.m. EDT

4 The moon passes 0.2° south of Jupiter, 5 a.m. EDT

5 Full moon is at 4:12 p.m. EDT

6 The moon is at perigee (222,223 miles from Earth), 9:02 a.m. EDT
Mars passes 0.9° north of Regulus, noon EDT (page 75)
The moon passes 1.8° south of Saturn, 9 p.m. EDT

9 The moon passes 0.4° north of Aldebaran, noon EDT

12 Last quarter moon is at 7:11 a.m. EDT

15 The moon passes 0.5° south of Regulus, 1 p.m. EDT
The moon passes 1.0° south of Mars, midnight EDT

20 New moon is at 6:09 a.m. EDT

21 The moon is at apogee (252,692 miles from Earth), 1:17 a.m. EDT
The moon passes 7° north of Mercury, 2 p.m. EDT
Orionid meteor shower peaks (page 75)

23 Saturn is at opposition, 3 p.m. EDT

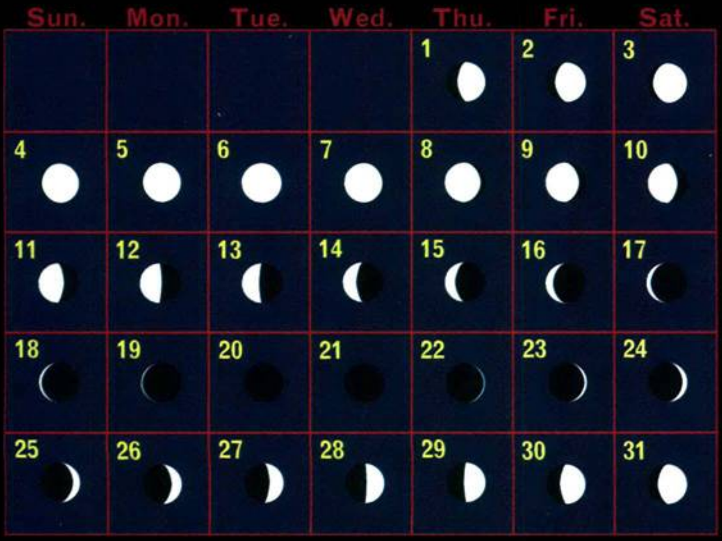
25 Asteroid Massalia is at opposition, 7 p.m. EST

27 Asteroid Juno is in conjunction with the sun, 8 p.m. EST
The moon passes 2° north of Neptune, 10 p.m. EST

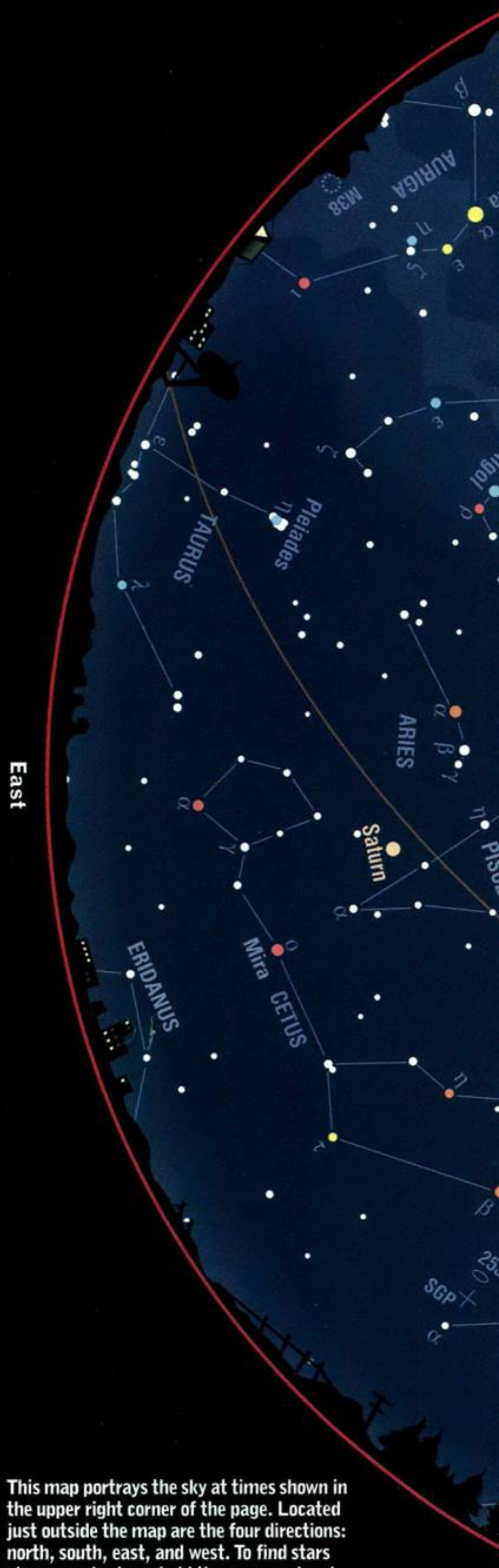
28 First quarter moon is at 6:46 a.m. EST
The moon passes 3° north of Uranus, 3 p.m. EST

29 Venus is in superior conjunction, 11 p.m. EST

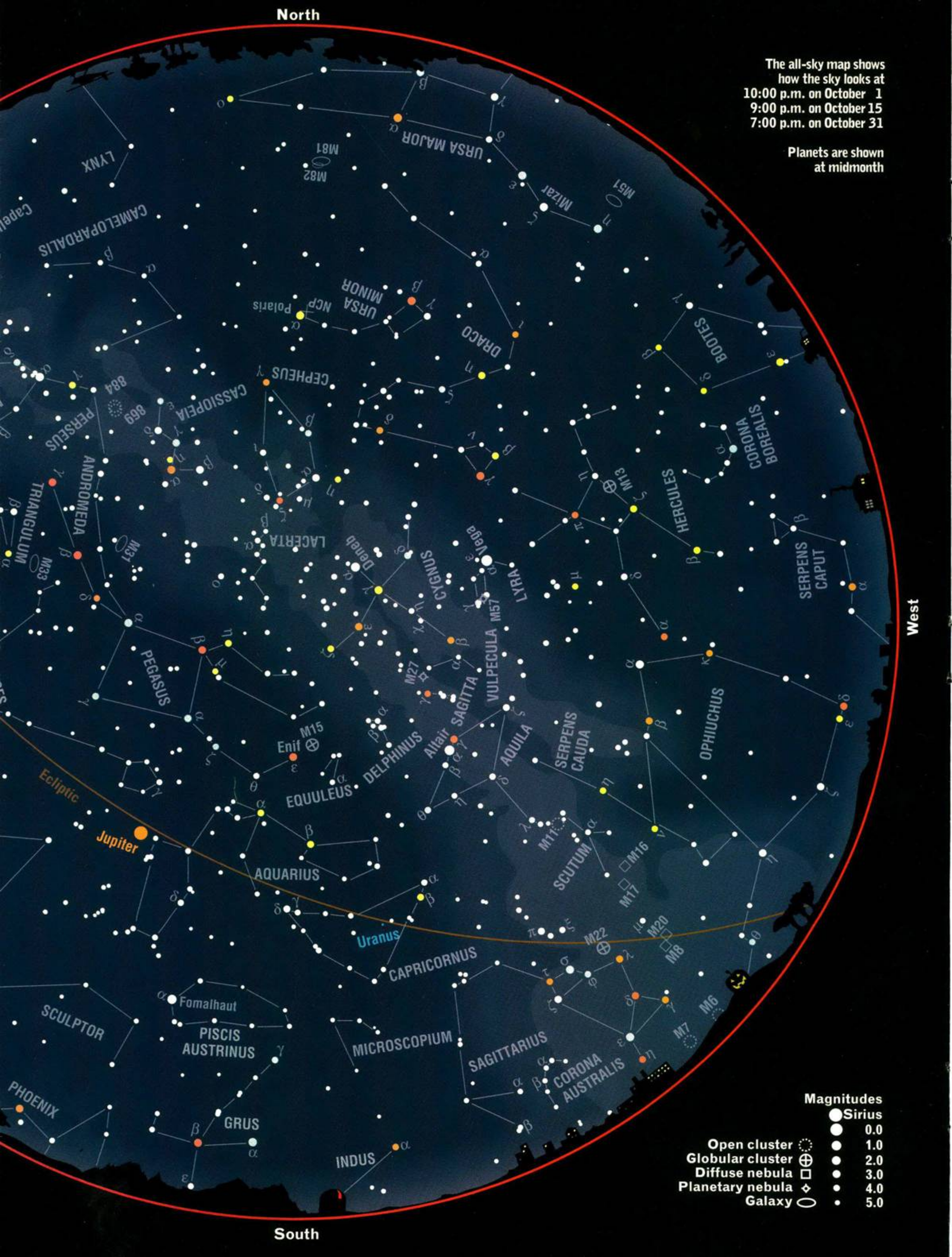
31 The moon passes 0.2° south of Jupiter, 11 a.m. EST



Sun.	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31



This map portrays the sky at times shown in the upper right corner of the page. Located just outside the map are the four directions: north, south, east, and west. To find stars above your horizon, hold the map overhead and orient it so a direction label matches the direction you're facing. The stars above the map's horizon now match what's in the sky.

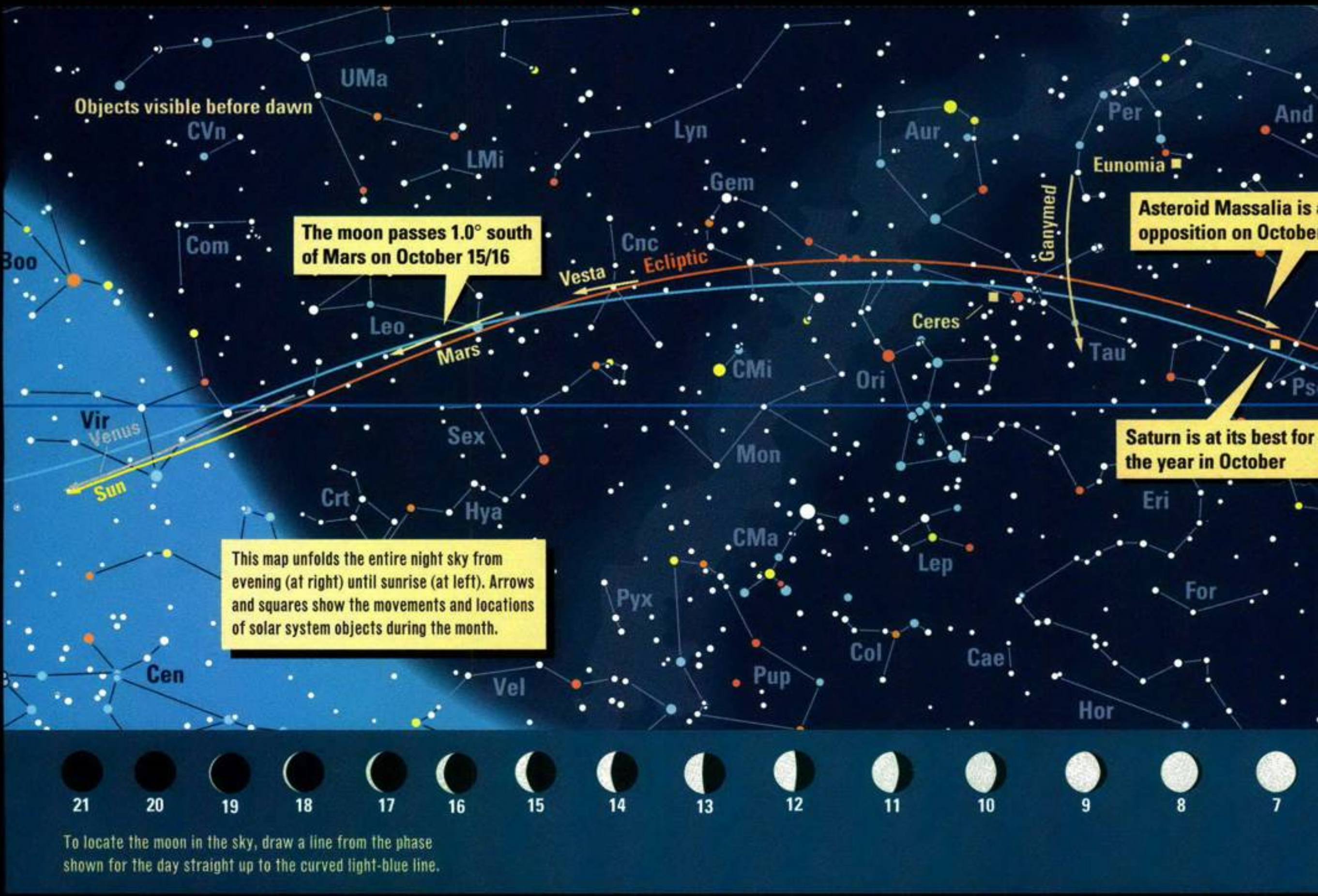


The all-sky map shows
how the sky looks at
10:00 p.m. on October 1
9:00 p.m. on October 15
7:00 p.m. on October 31

Planets are shown
at midmonth

North
South
West
LYNX
CAMELOPARDALIS
URSA MAJOR
M81
M82
Mizar
M51
URSA MINOR
NCP
Polaris
DRACO
CEPHEUS
CASSIOPEIA
PERSEUS
869
884
ANDROMEDA
TRIANGULUM
M33
M31
LACERTA
Deneb
CYGNUS
Vega
LYRA
M57
BOOTES
CORONA BOREALIS
HERCULES
M13
SERPENS CAPUT
OPHIUCHUS
VULPECULA
M27
SAGITTA
PEGASUS
M15
Enif
EQUULEUS
DELPHINUS
Altair
AQUILA
SERPENS CAUDA
M11
SCUTUM
M16
M17
M20
M8
M22
M6
M7
Ecliptic
Jupiter
AQUARIUS
Uranus
CAPRICORNUS
Fomalhaut
SCULPTOR
PISCIS AUSTRINUS
MICROSCOPIUM
SAGITTARIUS
CORONA AUSTRALIS
PHOENIX
GRUS
INDUS
Magnitudes
Sirius
0.0
1.0
2.0
3.0
4.0
5.0
Open cluster
Globular cluster
Diffuse nebula
Planetary nebula
Galaxy

THE PATH OF THE PLANETS


UMa
CVn
LMi
Lyn
Aur
Per
And
Eunomia
Boo
Com
Gem
Cnc
Ecliptic
Vesta
Ganymed
Leo
Mars
Ceres
Tau
CMi
Ori
Ps
Vir
Venus
Sun
Sex
Mon
Crt
Hya
Eri
CMa
Lep
Pyx
For
Col
Cae
Cen
Vel
Pup
Hor
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7

Objects visible before dawn

The moon passes 1.0° south of Mars on October 15/16

Asteroid Massalia is a opposition on Octobe

Saturn is at its best for the year in October

This map unfolds the entire night sky from evening (at right) until sunrise (at left). Arrows and squares show the movements and locations of solar system objects during the month.

To locate the moon in the sky, draw a line from the phase shown for the day straight up to the curved light-blue line.

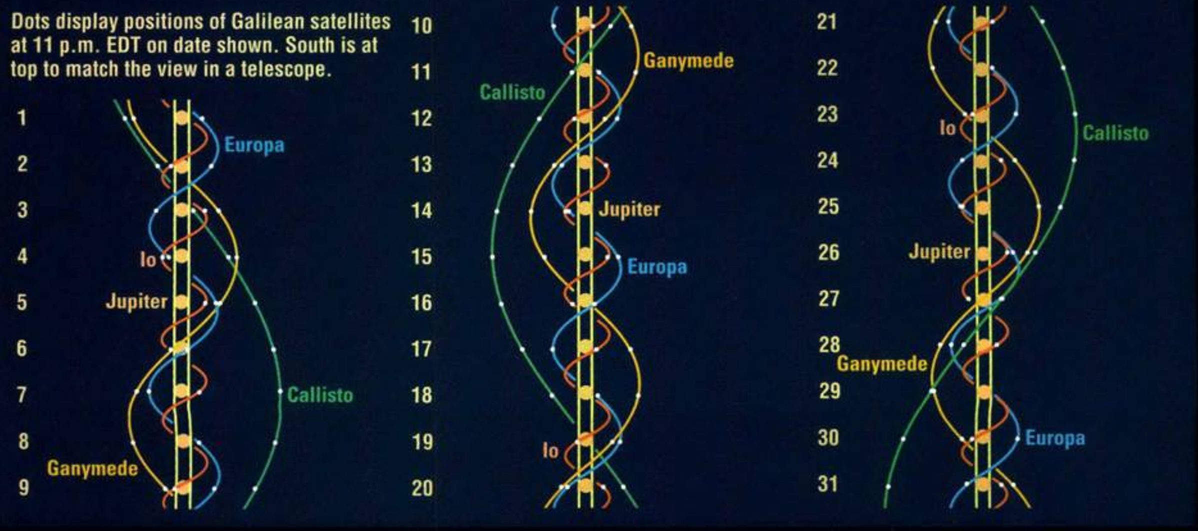
10"

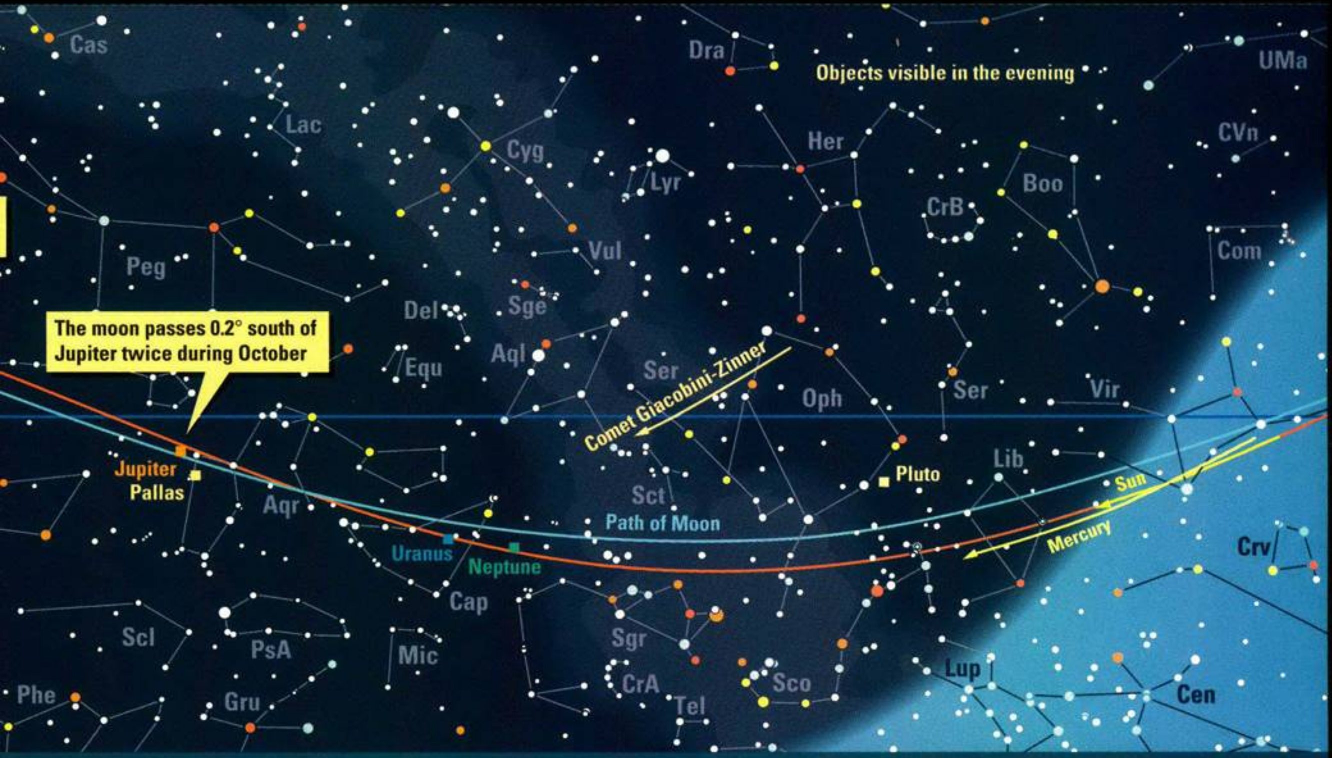
S
W — E
N

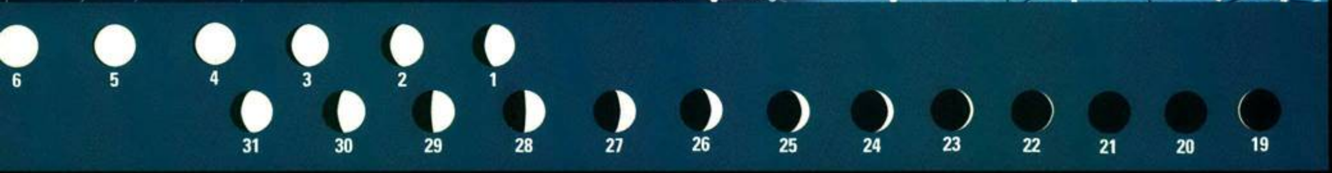
PLANETS	MERCURY	MERCURY	VENUS	MARS	JUPITER
Date	October 15	October 31	October 15	October 15	October 15
Magnitude	−0.5	−0.2	−3.9	1.7	−2.8
Angular Size	4.9"	5.5"	9.7"	4.3"	48.2"
Illumination	94%	82%	100%	95%	100%
Distance (AU) from Earth	1.376	1.214	1.712	2.158	4.089
Distance (AU) from Sun	0.463	0.450	0.721	1.647	4.964
Right Ascension (2000.0)	14h08.2m	15h39.9m	13h06.7m	10h27.8m	23h24.2m
Declination (2000.0)	−13°37'	−21°52'	−5°42'	11°07'	−5°31'

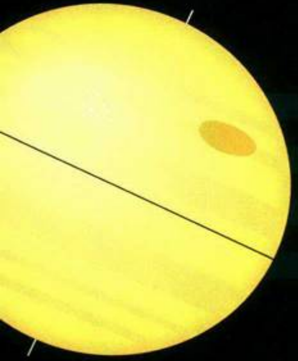
JUPITER'S MOONS

Dots display positions of Galilean satellites at 11 p.m. EDT on date shown. South is at top to match the view in a telescope.

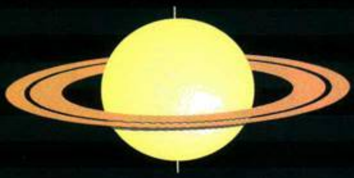



Cas
Dra
Objects visible in the evening
UMa
Lac
Cyg
Lyr
Her
CVn
Boo
CrB
Peg
Vul
Com
Del
Sge
The moon passes 0.2° south of Jupiter twice during October
Equ
Aql
Ser
Comet Giacobini-Zinner
Oph
Ser
Vir
Jupiter
Pallas
Aqr
Sct
Pluto
Lib
Sun
Path of Moon
Mercury
Uranus
Neptune
Crv
Cap
Scl
PsA
Mic
Sgr
Phe
Gru
CrA
Tel
Sco
Lup
Cen

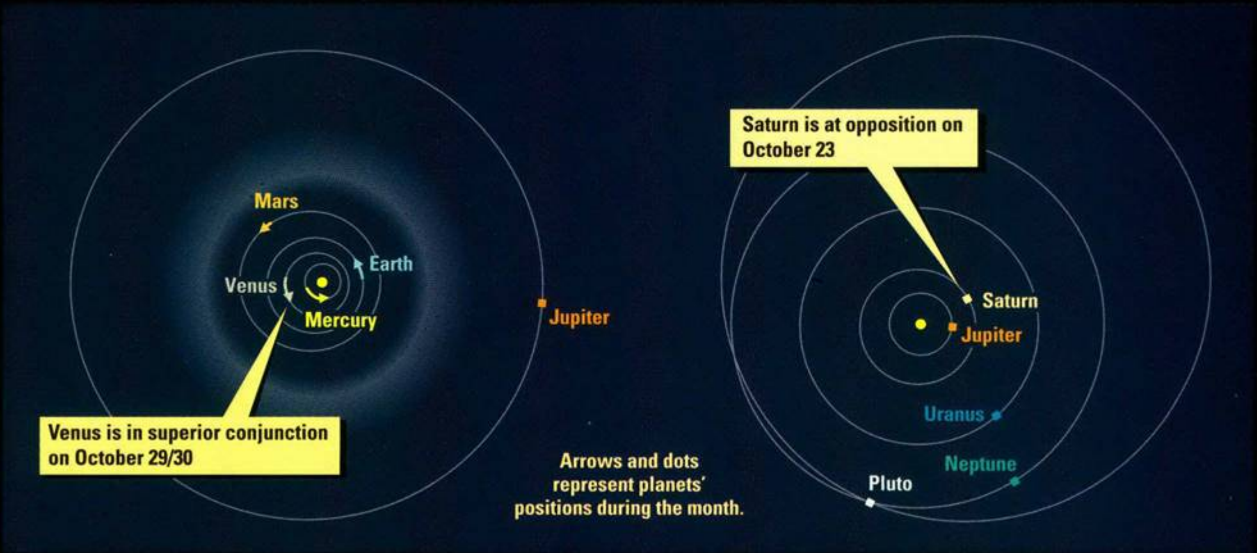

6
5
4
3
2
1
31
30
29
28
27
26
25
24
23
22
21
20
19



SATURN	URANUS	NEPTUNE	PLUTO
October 15	October 15	October 15	October 15
–0.2	5.8	7.9	13.8
20.0"	3.6"	2.3"	0.1"
100%	100%	100%	100%
8.305	19.557	29.982	30.785
9.290	19.878	30.136	30.101
1h58.9m	20h45.8m	20h06.0m	16h25.6m
9°11'	–18°41'	–19°57'	–9°58'



THE PLANETS IN THEIR ORBITS


Mars
Earth
Venus
Mercury
Jupiter
Saturn
Jupiter
Uranus
Neptune
Pluto

Saturn is at opposition on October 23

Venus is in superior conjunction on October 29/30

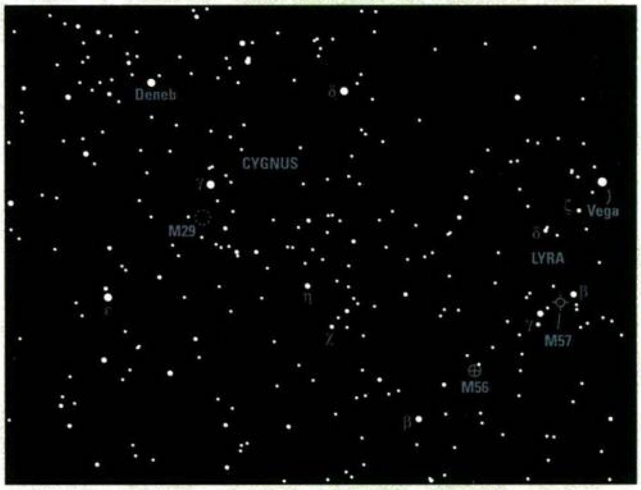
Arrows and dots represent planets' positions during the month.

FIRST VIEW: Chi Cygni, the Ruby in the Northern Cross

After two or three years of sky watching, observers may say. "Hey, what's that extra star doing in the long arm of Cygnus?" They've just discovered the long-period variable star Chi (χ) Cygni.

Although this star was likely noted in earlier times by court astronomers, the credit for its discovery goes to Gottfried Kirch in 1686. The variable was bright enough that Bayer put it in his *Uranometria* atlas as Chi Cygni, but by the next year the star had disappeared. A few years passed before the star's approximate 406-day period was estimated reliably.

Normally Chi Cygni hides in the background, fainter than magnitude 12, but at its typical maximum it reaches naked-eye visibility with a magnitude of 4 or 5 — its brightest has been recorded at 3.5. By now the fiery ember is probably bright enough to be seen with the naked-eye — displaying a delightful orange-red hue in binoculars. As Cygnus gradually swings lower in the evening sky this fall, keep an eye on Chi's brightness by comparing it to nearby stars. Binoculars will always help in the city, but most observers will need them anyway as Chi gradually fades back down to below naked-eye visibility.



All illustrations by *Astronomy*: Elisabeth Rowan

John Chumack

Chi Cygni is a Mira pulsating red giant. This class of stars' most interesting characteristics is that no two maxima are alike. Scientist aren't sure of how bright the star will be this year, but you can keep your own record by comparing it to other stars. Chi Cygni's cycle is a wonderful yardstick for measuring time along your path as a night sky observer.

the Eagle and Cygnus the Swan, are now flying westward. The twosome is accompanied by Lyra the Harp — the third constellation of the three that hold the stars of the Summer Triangle: Altair, Deneb, and Vega.

At this time of year, the summer stars seem to linger above the western horizon longer than usual. This is due to the rapidly changing onset of twilight. Although the stars set four minutes earlier every night, the sun is setting over a minute earlier — an indicator of the winter season to come.

Apart from the moon, the first object to pierce the fading twilight is **Jupiter**. The planet is only a couple of weeks past opposition and rising in the southeast by nightfall. For the first few days of the month, it maintains a dazzling magnitude of –2.9 and only shaves one-tenth of a magnitude off for the rest of October. This very small dimming is due to the planet's slightly increasing separation from Earth.

The largest planet in the solar system also gives the largest planetary image of any in Earth's skies — almost 50" across, which is the same apparent size as the crater Copernicus on the moon. Set among the stars of the Water Jar in Aquarius, Jupiter remains visible almost all night. This gives observers with telescopes ample time to view the four largest dancing moons that change position hourly. In addition, the dynamic atmosphere of Jupiter also changes hourly. These atmospheric changes are due to the planet's amazingly fast rotation period of 9 hours 50 minutes. During one clear night in October, you can watch the entire face of Jupiter rotate before you.

The sky becomes dark enough to search for **Neptune** roughly an hour after local sunset. The planet lies more distant from the sun than **Pluto**, a situation that will change in February of next year. Neptune shines at magnitude 7.9 and lies on the Sagittarius/Capricornus border west of Sigma (σ) Capricorni. Its path across the sky slows almost to a halt on October 11 — largely due to Earth moving directly away from Neptune in our orbit around the sun. Consequently, don't expect to see much of a change in position of the dim bluish planet against the background stars.

Uranus is making similar moves, or lack there of, coming to its stationary point on October 18. At magnitude 5.8 it's much brighter than Neptune and an easy binocular object to the southeast of Upsilon (υ) Capricorni. Both outer planets remain above the horizon until after midnight, but catch them soon after sunset before they move closer to the horizon and our turbulent atmosphere spoils the view. This is the most favorable month of the year to catch these two distant wanderers.

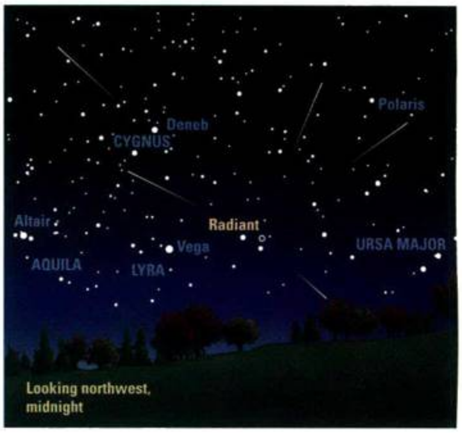
To the east of Jupiter, standing above the eastern horizon by nightfall, is the planet **Saturn**. Saturn reaches opposition on October 23 and remains visible all night. The bright planet can be spotted easily among the stars of Pisces the Fish. A yellowish glow at magnitude 0 is the brightest the planet has become in years. This is due, in large part, to the opening view of the southern face of the ring system. The widening of the rings will continue until 2002.

Focusing an 8-inch telescope on Saturn will show at least six moons. The brightest, Titan, is the target of the European Space Agency's Huygens probe that will arrive aboard the Cassini spacecraft in 2004. Titan shines at magnitude 8 and takes just over two weeks to orbit Saturn once. So during October, you can watch the moon as makes its trek around the planet for nearly two complete orbits.

See the Dragon's Tears

The dust from Comet Giacobini-Zinner's tail will be burning up to create meteors when Earth sweeps through the comet's orbital plane. Because this is a relatively fresh comet, its dust has not yet had a chance to spread out all the way around its orbit. We see the Giacobinids only when the comet is nearby, not every year like the famous Perseids of August.

Our proximity to the comet this year may produce a good shower with many bright meteors. For this event, the maximum is expected to be on the evening of October 8, though it may arrive as late as October 10 — plan to observe on several nights.

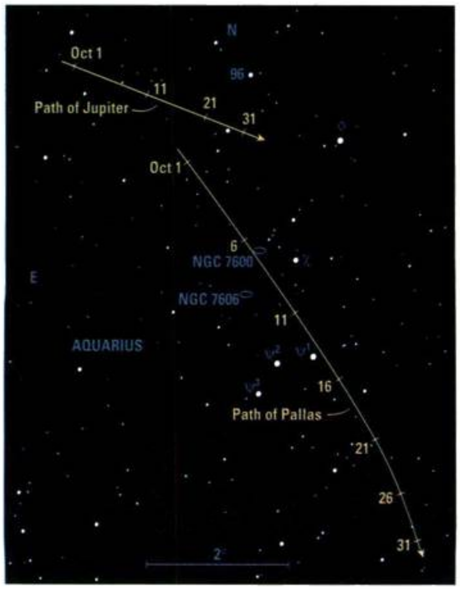


The meteors will appear to come from the head of Draco the Dragon, giving this shower the name Draconids. These meteors sweep across the sky at a leisurely speed, only one-third as fast as the swift Perseids. While many showers peak in the wee hours after midnight, the best time for the Draconids will be in the early evening hours. At this time, the radiant is highest in the sky and the moon has not yet risen.

Bundle up, grab a deck chair, a blanket, and a thermos of something warm to drink, then gather with friends for a relaxing evening of observing. This will be your last chance to capture a glimpse of the Dragon's tears for another six years. It will also hone your meteor spotting abilities for next month's Leonids.

Pallas Arcs Through Aquarius

We've been following asteroid 2 Pallas for a couple of months now because it has been passing some interesting deep-sky objects. Pallas is a snap to find because it lies in the same finder field as Jupiter — only 2° to the west at the start of the month.



At magnitude 8.5 Pallas will not be a snap. You'll need the finder chart to locate it against the modest starry backdrop of Aquarius. Pallas gets occulted by the moon on Saturday night, October 3–4. The moon's brightness relative to Pallas makes this event a challenge.

By the evening of October 7, Pallas appears to be a "guest supernova" in the 12th-magnitude galaxy NGC 7600. The asteroid passes 6' away on the southeast flank of this fuzzy galaxy. Some readers may remember last year's false supernovae sightings triggered by asteroids. In contrast, Pallas's speedy motion should be noticeable in the course of an evening. On October 10, Pallas slides 30' north of the magnitude 11.5 galaxy NGC 7606, and on October 14 it slides 10' north of magnitude 4.2 Psi^1 (ψ^1) Aquarii.

Iapetus, orbiting farther out than Titan, is the most enigmatic moon of the Saturnian system. One hemisphere is dark and black, while the other hemisphere is bright. Iapetus has a captured rotation like our own moon. One result of this is that the same side of the moon always faces Saturn. Here on Earth, we see the alternate sides of Iapetus at its eastern and western elongations. Iapetus is brightest at its western elongation on October 1. Throughout the rest of the month, Iapetus will move slowly to the south of the planet and begin to fade.

While the giant planets play out their nightly performance, the stars themselves act out their annual ritual. October is the best time to view Capricornus the Sea-Goat. Greek legend identifies Capricornus with the god Pan who leapt into the Nile to escape the god Typhon. Midway into this dive, his hindquarters, which were in the water, turned into a fish. His head, which was still above water, turned into a goat.

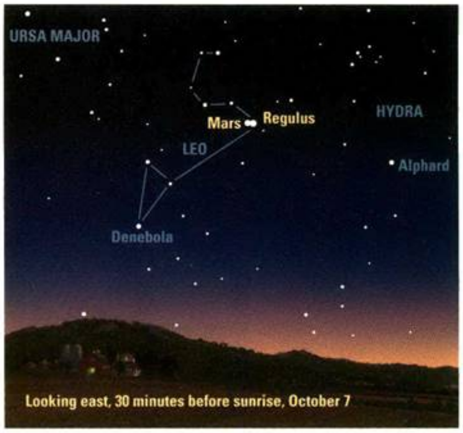
Two thousand years ago the sun was in Capricornus at mid-winter. The Greek astronomer Hipparchus named the southernmost latitude at which the sun rested overhead on the winter solstice the "Tropic of Capricorn." Over the years, precession (Earth's slight wobble on its axis) has moved the sun into Sagittarius at midwinter. Today, a more correct name for this southernmost latitude point would be the Tropic of Sagittarius.

To the northwest of Capricornus lies Aquarius the Water-Bearer, currently home to Saturn. Following

Ochre, Aquamarine, and Gray

Color contrasts are one of the joys of naked-eye observing. This month, the red planet Mars slides past Regulus in the morning sky.

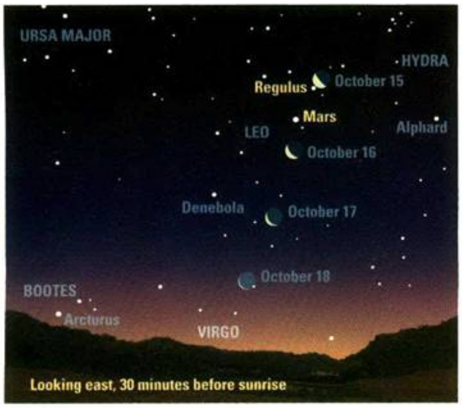
Mars begins the month only 4° above Regulus, close enough to compare them in binoculars, enhancing the colors. At magnitude 1.6, Mars is only slightly fainter than magnitude 1.4 Regulus. Try to picture the star sitting almost 70 light-years behind nearby Mars, which is a mere 18 light-minutes away.



Looking east, 30 minutes before sunrise, October 7

Our earthbound perspective shows the sun in its never ending eastward motion against the sky, carrying Mars along for the ride. It seems as if Regulus climbs upward past Mars. The two are only 0.9° apart on the morning of October 7. On October 15, the waning crescent moon shines 3° to the upper right of Regulus and on October 16 it can be found 4° below Mars. The bright gray landscape of the moon contrasts sharply with the color of the star and planet.

Fans of Cheshire-thin crescent moons will want to rise early on the morning of October 19 — only 23 hours before new moon. Observers on the west coast can attempt to see a thinner 20-hour crescent.



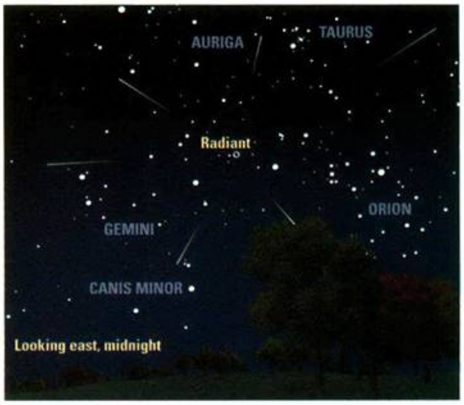
Looking east, 30 minutes before sunrise

Children of Halley

Except for a Draconid storm, the best meteors of October are the Orionids. This stream of dust that turns into shooting stars was born of the tail of Halley's Comet. The comet is so prolific and long lasting that its dust has had the time to fill the comet's orbit — giving us a reliable meteor shower. The question is, will it be upstaged by the Draconids this year?

Luna cooperates quite nicely by sitting squarely at new during the Orionid maximum on the night of October 21–22. The meteors will appear to radiate from Orion's club, which is tucked up between Gemini and Taurus. The best time of the night to see these meteors will be after midnight, when this area is reasonably high above the eastern horizon.

Orionids are swift meteors, and observations tell us that many leave trails. Remember to pack your binoculars and have them ready to pounce on the trails — it's interesting to watch them twist in Earth's rarefied upper atmospheric winds. Expect to see 10 to 15 meteors per hour.

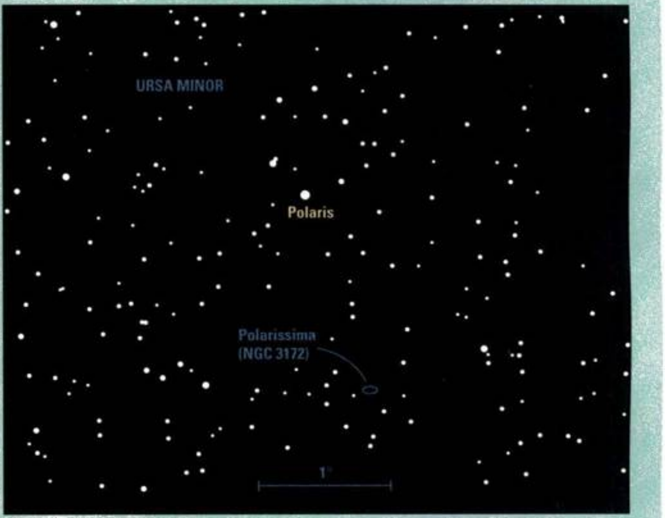


Looking east, midnight

OBSERVER'S CHALLENGE: Polarissima Borealis

There is a point in a deep-sky observer's pursuit of the hobby when he or she must seek the closest galaxy to the North Pole. Coined by its discoverer, Sir John Herschel, NGC 3172 is easily remembered as Polarissima Borealis.

Observers willing to take up this challenge will need at least a 10-inch telescope. You'll also need a very dark and moonless sky. Polarissima Borealis has a visual magnitude of 13.8. This is not an easy object — even for seasoned observers.



Al Kelly

To find NGC 3172, star hop using the map we've provided. Your next step is to boost the power past a magnification of 150x. If your magnification is below 100x, the galaxy's 1.1' by 0.8' oval may be too small to readily see. Those with telescopes that are equatorially mounted face the additional challenge of Polarissima's location. Its proximity to the pole may make it tough for you to align your telescope on it. Observers with a Schmidt-Cassegrain telescope have an added problem if the telescope won't allow you to use a star diagonal when it's pointing at the pole. If this is the case, you'll have to purposely misalign your mount by roughly 90° to make Polarissima easier to see.

While observing NGC 3172, increase the power to a high magnification. You should notice a diffuse face that grows brighter into its core. Speaking of higher power, that's what you'll need on a 16-inch or larger scope to nab the fainter companion to Polarissima, MCG +15-01-010. It has a magnitude of roughly 15.5 to 16. I stumbled onto this fainter fuzzy patch while looking at a Palomar Observatory Sky Survey print. I have yet to learn of anybody seeing it visually. So, if you are up for this even tougher challenge, go for it. Those with large scopes, good skies, and even better eyes may just have a shot at it. Let us know how you did.

Aquarius across the sky is a pair of watery constellations, Cetus the Whale and Pisces the Fish. These two star groups are relatively large though a bit faint. The easiest way to find Pices is to look for the constellation Pegasus the Winged Horse. The four stars of the Great Square marking the horse's body can guide you to Pisces below and to the east.

To Northern Hemisphere observers, Pegasus is upside-down. The line of stars that extends from the Great Square to the southwest and ends with the 2nd-magnitude star Enif marks his head and neck. West of Enif is the Little Horse, Equuleus, a tiny, dim constellation that separates Pegasus from Aquila the Eagle.

The broad summer Milky Way sets with Sagittarius not long after sundown. Take time early in the evening to spot the great rift that runs the length of Cygnus down to Aquila then swings west. By mid-evening King Cepheus and his Queen Cassiopeia hold high court far above the northern horizon, while their daughter Andromeda, with her beautiful galaxy, passes practically through the zenith for observers at mid-northern latitudes.

Perseus rises high in the northeast during mid-October evenings, following Cassiopeia's trail. This region is full of star clusters, making it very rewarding to scan with 7x50 binoculars. Move down to Auriga the Charioteer, found low in the northeast, for more open clusters. Three of them are in Messier's catalog: M36, M37, and M38. Rising with Auriga is Taurus the Bull.

The Pleiades are always the first indication that Taurus is on its way. This open star cluster rises around 9 p.m. local time and seems to bring along a chill in the air, a sign of the approaching winter.

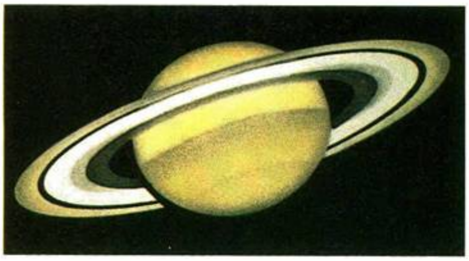
It is a long wait to see **Mars** rise among the stars of Leo the Lion at 4 a.m. On October 7 Mars lies only 0.8° northeast of Regulus, the bright first-magnitude star of Leo the Lion. Both glow with a similar brightness — Mars shining at magnitude 1.7 and Regulus a fraction brighter at 1.4. The pair offers a beautiful and stunning color contrast — the orange of Mars shimmers adjacent to the blue-white diamond of Regulus. This beautiful pairing in the early morning is a sight not to be missed. On the same morning, look for the minor planet Vesta at magnitude 8.3. It will be moving less than a degree south of the Beehive Cluster (M44) in Cancer the Crab.

Mars moves away from Regulus quickly by the time a waning moon joins them on October 15. By October 16, Mars rises a half-hour later. You can find the crescent moon only 4° to the planet's southeast.

A favorable position of the moon aids meteor observers this month. The Orionid meteor shower reaches a peak on October 21. The new moon the day before helps keep the sky dark, so take a trip out to the countryside to view the latest fiery exit of cometary debris as it burns up in our atmosphere. Earlier in the month we might have a treat with the Draconid meteor shower. Although moonlight interferes, this shower's parent comet, Giacobini-Zinner, returns to perihelion (closest orbital point to the sun) on November 8. The shower only occurs when the comet is nearby, so the rare appearance of these meteors is worth watching. ■

Martin Ratcliffe is Director of Theaters at the Exploration Place in Wichita, Kansas. Alister Ling is a meteorologist working for Environment Canada in Alberta.

A Mask for Saturn?



Mark S. Daniels

For most kids, October means that Halloween is coming soon. With Saturn rising just after dark, Halloween is a perfect time to show off the ringed wonder to all the little goblins, ghosts, and Godzillas coming up your front path.

In fact, Saturn rises at sunset on October 23, in opposition to the sun. The only unfortunate part of this: The shadow of Saturn's globe on the rings vanishes because it's directly behind the planet. The planet is tilted such that the shadow is lost to our line of sight. If you catch Saturn early in the month, you can spot a sliver of blackness on the rings. For the next decade, we'll be peering at Saturn's south pole tilted toward us.

Masking down the telescope can be really good for observing Saturn. When the telescope is pointed fairly low in the sky, the light rays have to travel through a lot of Earth's turbulent atmosphere. By placing a mask over the front of the scope that allows a 3- or 4-inch circle of light to reach the mirror, the image quality can be improved dramatically. Set it up so that the masked area covers the spider vanes and the secondary mirror. You can also be creative for Halloween night with a mask appropriate for the occasion.

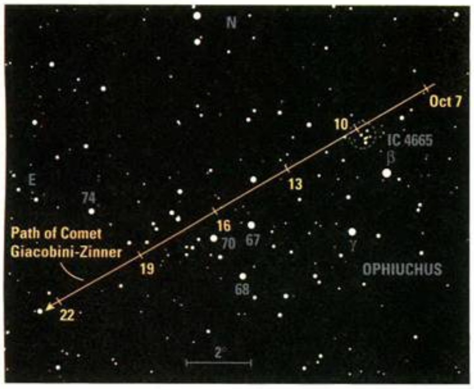
Periodic Comet Giacobini-Zinner

Uwe Fink et al., Lunar and Planetary Lab, University of Arizona

The first comet visited by a spacecraft was not Halley, but Comet Giacobini-Zinner. NASA redirected a solar-wind observing satellite named ISEE-3 toward it. During the 1985 fly-by, Giacobini-Zinner was sporting a beautiful dusty tail.

The comet's current foray into the inner solar system is a fair pass, brightening to magnitude 10 this month and 9 in November. Because it is still relatively dim, you'll want to get out to dark skies to get a good look. The moon will also play havoc with your observations. Try to get out on October 8 to 21 when Luna will not be in the evening sky.

Start your observations at low power to locate the comet. See how far you can trace its stubby tail. Increase the magnification and check out the inner coma for possible jet activity — it may be a little early, but the effort is often rewarding.



On October 10, Giacobini-Zinner can be found in the midst of the large bright star cluster IC 4665 in northern Ophiuchus. Over the next few nights, the comet slowly slides eastward just north of the bright chain of stars that includes Gamma (γ), 68, 70, and 67 Ophiuchi. Don't forget to drop in on the star clusters NGC 6633 and IC 4756, only 5° north and northeast.

CELESTAR 8 TELESCOPES

Lowest Prices Ever!

CELESTRON
CELESTRON

CELESTAR 8

- An economical but full featured 8" Schmidt-Cassegrain. A considerable amount of engineering work went into the design of the Celestar 8 to offer the **lowest price ever** on a Celestron fork mounted 8" with so many features.
- No sacrifice was made in the optics. The unsurpassed superior quality Celestron hand-figured system delivers diffraction-limited optics. Starbright® coatings are standard.
- The electronics are DC for easy astronomy on the go.
- The totally cordless electronics have a built-in drive corrector which is activated when using the optional hand control. The R.A. motor's main tracking speed is an accurately regulated sidereal rate. The optional hand control allows for fast and slow override of R.A. tracking speed and ± operation of the optional DEC motor. A comment from the *Sky & Telescope* review — "the digital electronics delivered a near-perfect sidereal tracking rate."
- The Celestar 8 is powered by a 9 volt alkaline battery.
- The Celestar 8 drive can operate in the Northern or Southern hemisphere from 0° to 90°.
- The new and unique Wedgpod is a combination tripod and wedge. It has a fixed height (33") and is lightweight without compromising its stability.
- Made in the U.S.A.
- Standard accessories included: 6x30 Finderscope, Star Diagonal – 1-1/4" and a 25mm SMA Eyepiece – 1-1/4" (81x).

CELESTAR 8 DELUXE

- This telescope utilizes the same superior optics used in all of Celestron's 8" Schmidt-Cassegrain telescopes and has all of the features of the Celestar 8, but is enhanced, for those who prefer a premium version of the spectacular Celestar 8.
- This model has a heavier duty fork mount and drive base, with a precision worm gear drive system.
- Superior tracking accuracy is attained with this drive system, which has four tracking rates and PEC (Periodic Error Correction).
- For the kind of versatility that makes observing a pleasure, the hand controller makes available a micro guide rate of .5x sidereal and a slew rate of 8x sidereal.
- The stepper motor drive electronics are cordless and operate on two 9 volt batteries.
- The Celestar 8 Deluxe has many features that are necessary for the more serious amateur astronomer, particularly if you're interested in astrophotography or CCD imaging.
- The standard accessories for this telescope include: a Declination Motor, Car Battery Adapter, Hand Controller, Wedge and a Tripod that's exceptionally rigid and sturdy, with adjustable height.
- Also standard is a large 9x50 Finderscope, and a multi-coated 26mm Plössl Eyepiece – 1-1/4" (78X).

CELESTRON
Advanced Astro Master

ADVANCED ASTRO MASTER®

The Celestar 8 Computerized and the Celestar 8 Deluxe Computerized telescopes are the same as the Celestar 8 and Celestar 8 Deluxe but with the addition of a factory **installed** and **tested** Advanced Astro Master®.

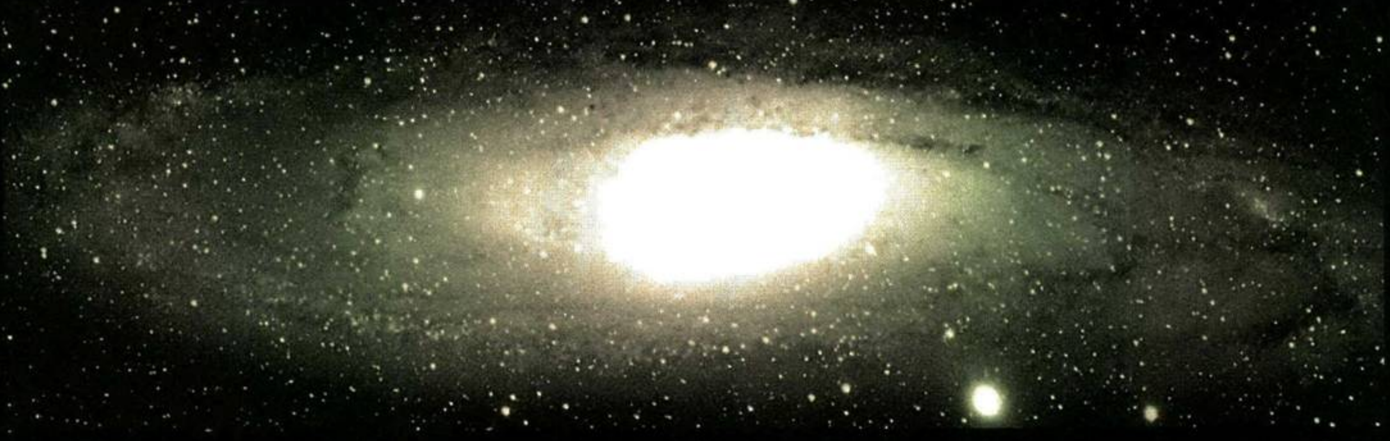
The pointing system contains a data base of over 10,000 objects. Once aligned, it will guide you to any one of these objects. Included are the entire RNGC catalog, the Messier catalog, IC catalog (selected objects), major planets, over 241 interesting double and multiple stars and a user definable catalog of 25 objects. Operates on a standard 9 volt battery.

Contains an RS-232 serial interface to enable usage with PC programs like "The Sky"™ by Software Bisque.

CELESTRON® *For more detailed information on these telescopes, contact a Celestron dealer or Celestron.*
Visit our WEB site at http://www.celestron.com

Celestron International • 2835 Columbia Street, Torrance, CA 90503 • (310) 328-9560 • FAX (310) 212-5835

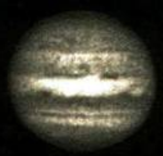
Can your 8" SCT do this?



Celestar 8 Deluxe with f/1.95 accessory and the new PixCel 237 CCD Camera allows this four part mosaic of 2 minute exposures

and this? **and this?** **or this?**

Ultima 2000 – 8" @ f/1.95 with the PixCel 237 CCD Camera



Celestar 8 Deluxe @ f/10 with the PixCel 237 CCD Camera

Celestar 8 Deluxe Computerized with f/6.3 reducer and PixCel 237 CCD Camera – two @ 10 minutes

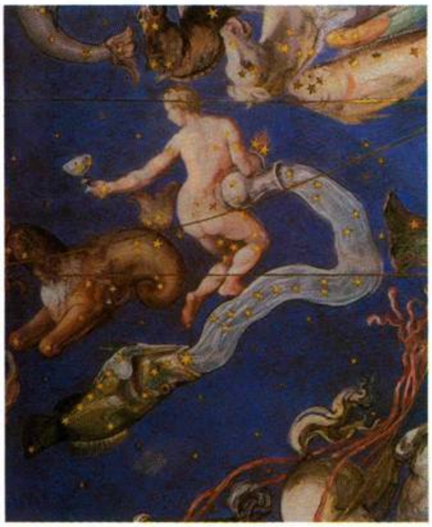
For an 8" SCT with real versatillity and muscle, consider the new Celestron Fastar compatible series telescopes. Ask for our new Fastar/PixCel color brochure or visit our Web site.

CELESTRON®

For full details on the complete line of Celestron CCD Cameras and the wide assortment of accessories available contact a Celestron dealer, Celestron or visit our web site.

Celestron International • 2835 Columbia Street, Torrance, CA 90503 • (310) 328-9560 • FAX (310) 212-5835

Aquarius & Piscis Austrinus



Lying squarely in the autumn void away from the Milky Way, the Water-Bearer and Southern Fish are chock-full of faint galaxies.

by Tom Polakis

AS THE CENTER OF THE GALAXY in Sagittarius departs with the arrival of autumn nights, you may be tempted to follow the Milky Way northward. At the same range of declinations as the busy "downtown Milky Way" region but culminating a couple months later are Aquarius and Piscis Austrinus. With hardly a recognizable star pattern to be found, it's no wonder this part of the sky is passed up. It shouldn't be, as there are plenty of objects to see in Aquarius.

Aquarius the Water-Bearer was so named due to the sun's entry into the constellation in early winter heralding the arrival of the rainy season. The most prominent asterism in Aquarius is the Water Jar, a Y-shaped grouping of four 4th-magnitude stars on the north edge of the constellation. Despite their apparent similarity, the stars of the Water Jar are a chance naked-eye alignment, showing widely varying proper motions and distances. Not apparent to the naked eye is that the luminous star Pi (π) Aquarii is ten times more distant than Zeta (ζ) Aquarii. Lambda (λ) Aquarii is an M-type giant that should appear reddish to the unaided eye.

Piscis Austrinus, the Southern Fish, is a smaller but perhaps more conspicuous constellation than Aquarius. It lies due south of the large constellation and is highlighted by 1st-magnitude Fomalhaut (Alpha [α] Piscis Austrini), which is among the 20 brightest stars in the sky. It is bright because it is only 25 light-years away. Fomalhaut is one of a chain of 4th- and 5th-magnitude stars that define the constellation well against the star-poor backdrop.

The globular cluster **M72** (NGC 6981) may be best found by beginning with the prominent stars of Capricornus and star-hopping northward. M72 is one of Charles Messier's fainter globulars, appearing only 4' across in a 13-inch telescope and revealing a faint haze of stars that are broadly concentrated but difficult to resolve. Two 10th-magnitude foreground stars appear 5' east of the cluster. Velocity measurements have shown that M72 is one of five "retrograde" clusters that orbit the Milky Way galaxy against its direction of rotation. The distance to the cluster is estimated at 53,000 light-years.

Today's observers typically view **M73** (NGC 6994) only to complete Messier's catalog of objects, as it consists of a clump of only four stars. Locate it a little more than one degree east of M72. The amount of "detail" will be the same in any scope. A nearly equilateral triangle of 11th- and 12th-magnitude stars with a fainter companion to the west are packed into an area only 1' across. It is still not certain whether or not the stars of M73 are physically associated. Some astronomers have used a statistical approach to argue that four stars of such similar brightness would probably not crowd into such a small space.

The **Saturn Nebula** (NGC 7009) is a magnificent sight through any instrument. Its name arises from the thin extensions, or ansae, at either end of the planetary nebula's disk which resemble Saturn's rings. These "wings" extend 15" from the ends of the oval disk, which itself is 25" long. At the end of the extensions are fainter bulbs that are barely visible in a 10-inch telescope on a good night. Using a 36-inch at the Ultimate Star Party in West Texas, Arizona observer Steve Coe easily saw the features as thickenings in the arms, which he calls

Artwork at left originally published in *The Glorious Constellations*, © 1991; Harry N. Abrams, Inc.

The Helix Nebula

Ken Blankenship and Dennis Batis

Kim Zussman

"wing tanks." The bulbs are thought to be cool, dense blobs at the boundary between the "slow-wind" and "fast-wind" stage of a planetary's evolution.

In my notes I call the Saturn Nebula "baby blue" when viewed at low magnifications, while some observers consider it green. Be sure to use direct vision when looking for color in astronomical objects, and save the averted vision for faint detail. In addition to the ansae, a large telescope at high power shows a small, hollow disk placed inside the fainter shell of the main disk.

M2 (NGC 7089) is a brilliant globular cluster that warrants repeated viewing. It lies about 5° north of 3rd-magnitude Beta (β) Aquarii and will turn up easily in a 7x50mm finderscope. From a moderately dark Arizona site, I was able to spot M2 with my naked eye as a fuzzy spot just brighter than the background sky. A 6-inch telescope resolves several dozen stars over an area 5' across and a 12th-magnitude star halfway to the east edge. The core is well compressed across this area, but the star count drops off quickly outside this bright center. Through a 10-inch scope you can expect a vast improvement, as numerous 13th and 14th-magnitude stars come into view and the cluster's size grows to 7'. With a 20-inch telescope in the desert, I was able to fully resolve the cluster into hundreds of stars across a 9' diameter. M2 is about 35,000 light-years away.

Our next object is a gorgeous double star that is easy to find. Zeta (ζ) Aquarii is the center star in the Water Jar. Point the telescope at it, and use the highest magnifications that seeing will permit. The two components form a bright pair of "headlights" that are currently separated by only 2.0". The system's lengthy orbital period of 856 years results in a pair that will maintain nearly this separation for a lifetime. Nebraska amateur David Knisely often uses this pair to test the steadiness of the night air. He constructed off-axis aperture masks for his 10-inch Newtonian to see what size scope is required to split Zeta. With 50mm of aperture at 220x, he saw an elongated blob, but at 60mm, he observed "notching," while only 70mm aperture was needed to show dark space between the components. His statement that 80mm aperture turned the pair into "an easy double" should provide inspiration to small-scope owners.

In the southwest corner of Aquarius lies the fine spiral galaxy **NGC 7184.** An 8-inch telescope reveals a halo extending to 4' by 1' in position angle 75°. The center is sharply concentrated and slightly brighter than the surrounding glow. In a 16-inch scope, the mottled detail of spiral arms becomes apparent, especially to the east of the core. A 12th-magnitude star similar in brightness to the nucleus shines in front of the galaxy's east end. The careful observer may notice two considerably fainter galaxies, **NGC 7180** and **NGC 7185**, to the north in the same medium-power field.

At a distance of less than 500 light-years, the **Helix Nebula** (NGC 7293) is among the nearest planetary nebulae. It is also one of the most studied objects of its class. Recent images from the

Jack Newton

The Saturn Nebula

Ken Blankenship and Dennis Batis

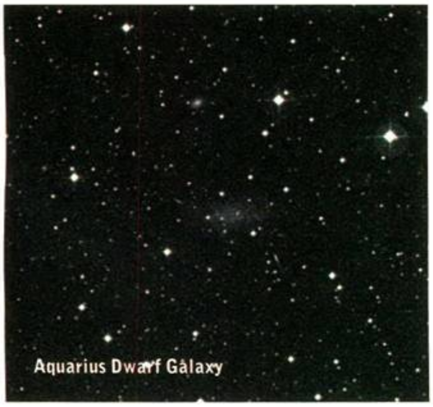
Martin C. Germano

Hubble Space Telescope show hundreds of curious features with tails pointing away from the central star dubbed "cometary knots." They have nothing to do with comets though. Velocity measurements have shown them to be slowly expanding clouds shed by winds from the central star in its red-giant stage that are being overtaken by faster shells ejected later in the star's life. A sample of 313 of these knots in a small portion of the Helix detected in one HST image was extended to infer that 3,500 of them surround the central star.

Despite the bright integrated magnitude of the Helix, its low surface brightness makes it difficult to see in a telescope. The advent of nebula filters has brought the Helix into visibility for small scopes. Even a 4-inch telescope will reveal its ring structure. Ten inches of aperture may begin to bring out the slightly brighter concentrations on the north and south edges. Much of the fine detail visible in photographs eluded my 20-inch scope, although the outer edge begins to show its filamentary nature. This same telescope clearly shows that the inside of the ring is brighter than the surrounding sky. Some observers have noted an extremely faint anonymous galaxy only 1' south of an 11th-magnitude star on the nebula's west end.

NGC 7492 is an extremely faint and sparse globular cluster that may require an 8-inch glass to be seen at all. My 13-inch brought out a half dozen or so of the cluster's brightest members against a pale glow, 4' across. The 20-inch only improved the star count to twenty, all of which are fainter than 15th magnitude.

The barred spiral galaxy **NGC 7606** should show up well in a 6-inch scope. It appears 3' by 1' in p.a. 150° and shows a bright core with tapering extensions.



Aquarius Dwarf Galaxy

Digitized Sky Survey

The Water Carrier and the Southern Fish

> *"Water, water, everywhere, And all the boards did shrink;*
> *Water, water, everywhere, Nor any drop to drink."*
> The Rime of the Ancient Mariner
> — *Samuel Taylor Coleridge*

That certainly is not the case for Picis Austrinus. This constellation is most often depicted as a fish on its back drinking all the water that flows from Aquarius's urn. But is that liquid actually water? Some myths relate the urn to a wine jar that holds the nectar of the gods.

Aquarius's association with water goes back to Babylonian times and the "curse of the rain." This curse stems from the fact that the sun was in Aquarius during the Babylonian monsoon season — his urn overflowing volumes. To predynastic Egyptians, Aquarius may have been associated with Osiris, the river- or water-god. Osiris later evolved into the king of gods with Hap or Hapi becoming the god of the Nile. The Egyptians also have a legend of Aquarius that associates the tidal rising of the Nile's waters to the setting of the constellation. As Aquarius sets, he adds the contents of his urn to the river, causing a rise in the water level.

In Greek mythology, Aquarius was Ganymede, the most beautiful boy alive and the son of King Tros. The myth recounts a story of Zeus seeing Ganymede and immediately being struck by the boy's beauty. The king of gods then sent his eagle, Aquila, to swoop down and carry the boy to Mount Olympus. There Ganymede became the wine steward to the gods, serving them the contents of his urn.

Picis Austrinus was called the Great Fish by Eratosthenes. Considered the parent of our northern fish, Pisces, the southern fish may have been the Syrian fertility goddess Derceto. There are several myths that revolve around Derceto falling into a lake or river. In one instance she was saved by a fish, in another she became a mermaid.

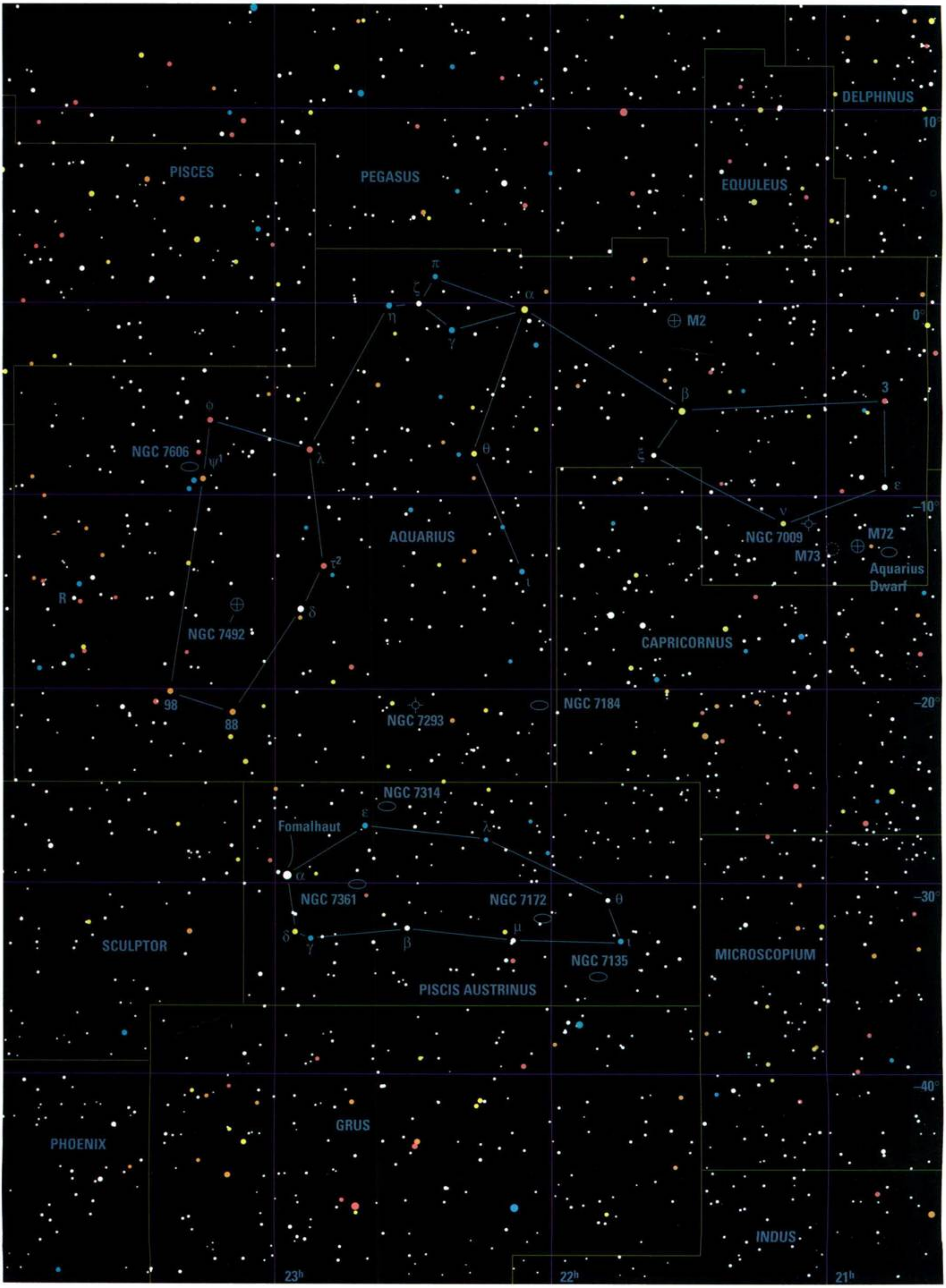
It's important to note that the constellations of Aquarius and Picis Austrinus are located in an area of the sky once known as the Water. This region also holds such aquatic constellations as Cetus the Whale, Capricornius the Sea Goat, Pisces the Fish, Eridanus the River, and Delphinus the Dolphin. —*Andrea Gianopoulos*

R Aquarii is a Mira-type star whose brightness varies irregularly with a 386-day period. It varies between magnitudes 6 and 12, but these values have proven to be quite unpredictable. R Aquarii is a symbiotic binary system in which a white dwarf star receives gas from the outer layer of a nearby red giant. The variable is currently on the upswing from a minimum that occurred in early June toward a maximum that takes place in December, when the star becomes lost in the solar glare.

Surrounding R Aquarii is a faint nebula known as **Cederblad 211**. A survey of the most dedicated deep-sky viewers who take on any challenge turned up only one observation by Californian Steve Gottlieb. He was unable to see the surrounding nebulosity with a 17½-inch telescope from the Sierra foothills, but the star itself appeared to respond to UHC and OIII filters. At 220x, he notes that he suspected but did not definitely confirm a short extension from R Aquarii to the northeast.

Scan 2° south-southeast of 4th-magnitude Iota (ι) Piscis Austrini to find **NGC 7135**, a faint galaxy with a nearby companion. NGC 7135 is about 1.5' across and round with some central brightening. A large equilateral triangle of 11th-magnitude stars is 3' to the west. In the same medium-power field to the west lies **NGC 7130**, which appears as a similarly faint haze, although smaller and with a broader concentration.

NGC 7172 is part of a small quartet of galaxies known as **Hickson 90**. The *Hickson Catalog of Compact Galaxy Groups* compiles 100 of these small groupings that are interesting for studies of galaxy interactions. NGC 7172 has been shown to be in early stages of interaction with **NGC 7173** and **NGC 7174** to the south, but **NGC**


DELPHINUS
10°
PISCES
PEGASUS
EQUULEUS
π
ζ
η
γ
α
M2
0°
β
3
φ
NGC 7606
ψ^1
λ
θ
ξ
ε
-10°
ν
NGC 7009
M72
M73
Aquarius Dwarf
AQUARIUS
τ^2
ι
R
δ
NGC 7492
CAPRICORNUS
98
88
NGC 7293
NGC 7184
-20°
NGC 7314
ε
Fomalhaut
λ
α
NGC 7361
NGC 7172
θ
-30°
μ
δ
γ
β
ι
SCULPTOR
NGC 7135
MICROSCOPIUM
PISCIS AUSTRINUS
-40°
GRUS
PHOENIX
INDUS
23h
22h
21h

Astronomy: Elisabeth Rowan

NGC 7606

Bill Iburg

NGC 7184

Digitized Sky Survey

NGC 7492

Digitized Sky Survey

7176 appears to be farther away and undisturbed. The system lies at a distance of about 90 million light-years. Through the scope, NGC 7172 is small, moderately bright, and elongated east-west. The three remaining members of Hickson 90 are clumped into a region 2' across and are faintly visible in a 13-inch telescope. Although NGC 7176 appears to be contacting NGC 7174 telescopically, remember that it is the one that is not interacting.

Locate **NGC 7314** a little over a degree northwest of Epsilon (ε) Piscis Austrini. It is fairly bright in an 8-inch scope, showing a halo that extends to 4' by 2', elongated north-south. The feeble glow of a stellar nucleus can be picked up in larger apertures during moments of good seeing. A little to the west of the southern tip of the haze look for **NGC 7313**, which appears round and very faint.

The lens-shaped galaxy **NGC 7361** is over three degrees west of Fomalhaut. It appears as a faint haze, 4' by 1', elongated north-south. There is almost no central concentration visible in the galaxy. Detail is difficult to see due to the presence of an 8th-magnitude star only 6' west.

The Local Group of galaxies has been a fascination for me for years. In our neighborhood 30 or so galaxies are near enough to be gravitationally bound and not moving outward with the cosmological expansion. The dwarf galaxies are often challenging telescopically, and the **Aquarius Dwarf Galaxy** is a good example. Through my 13-inch scope working from a very dark site in the Arizona desert, I was only able to hold this galaxy as a 2' uniform haze at magnifications under 115x. See if you can pick this dim object up on a crisp autumn evening. ■

Tom Polakis is an aerospace engineer living in Arizona. His primary astronomical interests are deep-sky observing and photography.

Deep-Sky Objects in Aquarius & Piscus Austrinus

Object	R. A. (2000.0)	Dec.	Mag.	Size/Sep./Per.	Type	Notes
Aqaurius Dwarf	20h46.9m	–12°51'	13.9	2.3' by 1.2'	Gal.	Local Group member
M72	20h53.5m	–12°32'	9.3	5.9'	GC	Conc. = 9
M73	20h59.0m	–12°38'	8.9	2.8'	OC	
NGC 7009	21h04.2m	–11°22'	8.3	25"	PN	Saturn Nebula
M2	21h33.5m	–0°49'	6.4	12.9'	GC	Conc. = 2
NGC 7135	21h49.8m	–34°53'	11.3	3.0' by 2.1'	Gal.	S0 pec
NGC 7172	22h02.0m	–31°52'	11.8	2.8' by 1.4'	Gal.	in Hickson 90
NGC 7184	22h02.7m	–20°49'	11.2	6.5' by 1.4'	Gal.	S(r)b
Zeta Aqr	22h28.8m	–0°01'	4.3, 4.5	2.0"	Dbl.	
NGC 7293	22h29.6m	–20°48'	7.3	13'	PN	Helix Nebula
NGC 7314	22h35.8m	–26°03'	10.9	4.2' by 1.7'	Gal.	SAB(rs)c
NGC 7361	22h42.3m	–30°03'	12.2	4.0' by 0.9'	Gal.	Sb
NGC 7492	23h08.4m	–15°37'	11.4	6.2'	GC	Conc. = 12
NGC 7606	23h19.1m	–8°29'	10.8	4.4' by 2.0'	Gal.	SBrsb
R Aqr	23h43.8m	–15°17'	5.8–12.4	386.96d	Var.	Mira type
Cederblad 211	23h43.8m	–15°17'	—	2' by 1'	RN	Surrounds R Aqr

Object: Designation in Messier, NGC, or other catalog. **R.A. (2000.0) and Dec.:** Right ascension and declination in epoch 2000.0 coordinates. **Mag.:** Visual magnitude. **Size/Sep./ Per.:** Size in arcminutes or arcseconds, separation in arcseconds, or period in days. **Notes:** Hubble type for galaxies or type for variable stars.

ALL TELESCOPES IN STOCK!

focus Camera & Video

4419-21 13TH AVE. BROOKLYN, N.Y. 11219

24-HOUR FAX LINE
800-TO-FOCUS
OVERSEAS FAX LINE
718-437-8811
CUSTOMER SERVICE
718-437-8899

BINOCULARS

CELESTRON

8x42 Regal	CALL	10x50 Regal	CALL
7x42 Ultima	CALL	7x50 Ultima	CALL
8x32 Ultima	189	8x56 Ultima	269
9x63 Ultima	CALL	10x42 Ultima	139.95

20x80 Giant . . . . . . .CALL

BLOWOUTS! 8x56 Pro . . .117.95 8x40 Pro 114.95
BLOWOUTS! Zoom Pro (#71119F) 98.99
How To Choose Binoculars 6.95

MEADE

8x25 Safari Pro	180	10x25 Safari Pro	200
7x36 WA Safari Pro	170	8x42 WA Safari Pro	180
10x42 Safari Pro	190	10x50 WA Safari Pro	200
7x42 WA Rainforest Pro	480	8x56 Rainforest Pro	500

Nikon. SPORT OPTICS

You'll Never See Things Quite The Same Again!

7x35 E . .279 8x30 E	256.95	10x70	1048.95
8x32 E Superior	469.95	7x50 Prostar	721.95
10x42 E Superior	588.95	10x40 Lookout IV	102.50
12x50 E Superior	669.95	10x50 Kestrel	142.95

SPOTTING SCOPES

Fieldscope II w/20x45	398.95	II Angled w/20x45	457.95
Fieldscope 60 ED II	574.95	60 ED II Angled	634.95
Fieldscope 78 ED	999.95	78 ED Angled	1069.90

BAUSCH & LOMB BUSHNELL

7x24 Elite	CALL	10x40 Custom	298.95
8x42 Elite	CALL	7x42 Discoverer	328.95
10x42 Elite	CALL	10x42 Discoverer	358.95

SPOTTING SCOPES

Discoverer 15-60x			171.95
Spacemaster	149.95	Kit	247.95
Spacemaster Armored	163.95	Kit	259.95
Spacemaster Zoom Black Armored			248.95

All Kits Include: 15-45x Eyepiece & Case or Pouch

FUJINON

6x30 FMT-RSX	CALL	8x30 FMT-RSX	CALL
7x50 FMT-SX w/Case	CALL	10x70 FMT-SX w/Case	CALL
7x50 FMTR-SX	CALL	16x70 FMT-SX w/Case	CALL
7x50 FMTRC-SX w/Compass			CALL
7x42 DCF Slim Style	CALL	7-21x40 ZCF Roof Prism	CALL
Super 80 Scope w/Case			CALL

ZEISS | SPALDING

15x60	CALL	20x80 Eagle View	279.95
20x60 Image Stabilizer	CALL	30x80 Eagle View	329.95
30x60 Spotting Scope	CALL	8-52x60 RA Zoom	259.95
20x60 Spotting Scope	CALL	10-30x50 RA Zoom	149.95

Leica

SPOTTING SCOPES
APO TELEVID 77mm
Ask About Leica
Passport Protection

SWAROVSKI OPTIK

SPOTTING SCOPES
CT-75 • CT-85
AT-80 • ST-80
AT-80 HD • ST-80 HD

TELRAD

Finder Scope $36.49

MEADE ADVANCED PRODUCTS

MAKSUTOV-CASSEGRAINS

ETX ASTRO TELESCOPE

EXQUISITE, DIFFRACTION-LIMITED IMAGING IN AN ADVANCED, ULTRA PORTABLE TELESCOPE SYSTEM!

Includes:
Batt. Powered Motor Drive, Table Tripod & 26mm Plossl

THE REVOLUTIONARY MEADE ETX 90mm Maksutov-Cassegrain telescope goes anywhere at a moment's notice and presents the finest optical images ever made available in an ultraportable telescope.

FOR THE CASUAL OR BEGINING OBSERVER the ETX may be all the telescope ever required: observe Jupiter, Saturn, Venus & Mercury. These are just a few of thousands of celestial objects within view of the ETX.

FOR THE ADVANCED ASTRONOMER who already owns a larger instrument, the ETX is the perfect telescope that can be hand carried aboard an aircraft or backpacked to the most remote observing sites.

ETX 90mm 1250mm f/13.8 . . . . . .**$595.00**

DLX ACC PACK SPECIAL! Center Tripod Leg (#07035), 64-T Adapter, #932 45° Erecting Prism, Carry Case.
CALL FOR SPECIAL PRICING WITH PURCHASE OF ETX

LX-50 7" f/15 w/Std Equatorial Wedge .**$1,795.00**
LX-200 7" f/15 w/Heavy Duty Fork Mnt **$3,295.00**

SCHMIDT-CASSEGRAINS

LX-10 8" w/Hand Controller	$995.00
LX-50 8" f/10	$1,395.00
LX-50 10" f/10	$1,695.00
LX-50 10" f/10 w/Super Wedge	$1,895.00
NEW! LXD 500 SERIES 203 8" f/10	$1,295.00
LX-200 8"	$2,795.00
LX-200 10"	$3,195.00
LX-200 12"	$4,495.00
LX-200 16"	CALL
LX-200SC 12" f/2.2 Schmidt-Camera	CALL

PICTOR SERIES CCD IMAGES

201-XT Autoguider/Imager	395	208-XT Autoguider/Imager	495
216-XT Autoguider/Imager	695	Off Axis Guider f/CCD	115
416-XT Autoguider/Imager *w/Free $800 Upgrade*			1,695
1616-XT Autoguider/Imager *w/Free $800 Upgrade*			5,495
616 Color Filter System f/416, 1616-XT			695
616A Color Filter System f/216	695	542 AC Adapter f/416, 1616	98.95
541 AC Adapter f/201, 208, 216			36.95
520 Electronic Relay f/201, 208, 216, 416, 1616			98.95

MAGELLAN I COMPUTER SYSTEMS

#2010, 2011, 2012 f/Dobs. & Equat.			295
#2014 f/LX-10			375

MAGELLAN II COMPUTER SYSTEMS

#2018 f/Equatorial 6", 8", 10"	495	#2019 f/Equatorial 16"	595
#2024 f/LX-50	495	Interface Cable f/LX-200	25
EPOCH 2000sk Sky Software 3.5" Disks	149	CD	179
EPOCH 2000ip Software 3.5" Disks			199

DOBSONIANS

STARFINDER 6" f/8	$349.00
STARFINDER 8" f/6	$449.00
STARFINDER 10" f/4.5	$599.00
STARFINDER 12" f/4.5	$895.00
STARFINDER 16" f/4.5	$1,195.00
Dobsonian Deluxe Accessory Package	$49.95

EQUATORIALS

STARFINDER 6" f/8 w/2" Focuser	$649.95
STARFINDER 8" f/6 w/2" Focuser	$749.95
STARFINDER 10" f/4.5 w/2" Focuser	$879.95
STARFINDER 16" f/4.5 w/2" Focuser	$2,695.00

ED APO REFRACTORS

***NEW!* 500 SERIES 102 Apochromatic** 4" f/9	$1,695.00
***NEW!* 500 SERIES 102 Achromatic** 4" f/9	$995.00
102ED 4" f/9 w/Mount, Tripod & Accessory	$2,795.00
127ED 5" f/9 w/Mount, Tripod & Accessory	$3,295.00
152ED 6" f/9 w/Mount, Tripod & Accessory	$4,995.00
178ED 7" f/9 w/Mount, Tripod & Accessory	$5,995.00
Optical Tube Only	CALL
1664 Electronic Drive	$349.00
1697 Computer Drive System	$695.00

REFRACTORS/REFLECTORS

223 60mm Altaz. *w/Free Star Locator Software!*	CALL
227 60mm Altaz. *w/Free Star Locator Software!*	CALL
230 60mm Altaz.	CALL
285 60mm Equat.	CALL
290 60mm Equat. *w/Free Star Locator Software!*	CALL
390 90mm Altaz.	CALL
395 90mm Equat.	CALL
4500 Newtonian	CALL

EYEPIECES

MODIFIED APOCHROMATIC

9, 12, 25, 40mm 1.25"	37.95	9, 12, 25, 40mm .96"	32.95

PLOSSL SERIES 3000

5, 6.7, 9.5, 16, 25mm 1.25"	49.95	40mm 1.25"	79.95

PLOSSL SERIES 4000

6.4, 9.7, 12.4, 15, 20, 26mm 1.25"			79.95
32, 40mm 1.25"	99.95	56mm 2"	199.95

PLOSSL SERIES 4000 SUPER WIDE ANGLE

13.8mm 1.25"	139.95	18mm 1.25"	149.95
24.5mm 1.25" . . . . .179.95 32mm 2"	239.95	40mm 2"	299.95

PLOSSL SERIES 4000 ULTRA WIDE ANGLE

4.7mm 1.25"	169.95	8.8mm 1.25"/2"	239.95
6.7mm 1.25"	199.95	14mm 1.25"/2"	299.95

ILLUMINATED RETICLE EYEPIECE SYSTEMS

Plossl 9mm 1.25" wireless	149.95	MA 12mm 1.25" wireless	99.95
Plossl 9mm 1.25" w/cord	129.95	MA 12mm 1.25" w/cord	79.95

BARLOWS

#122 2x Telenegative 1.25"	44.95	**#127** 2x-3x Variable 1.25"	56.95
#126 2x Short Focus 1.25"	44.95	**#134** Achromatic .96"	44.95
#140 2x Apochromatic 1.25"			71.95

ACCESSORIES

#62 T-Adapter f/SCT	26.95	#931 45° Hybrid Erect Prism	42.95
Off Axis Guider	79.95	607 25' Cigarette Adapter	24.95
f/6.3 Focal Reducer	129.95	55 Manual DEC Control	74.95
Basic Tele-Extender	29.95	#1205, 1206, 1207 Focuser	CALL
Variable Tele-Extender	39.95	6x30, 8x50 Viewfinder	CALL
Camera Adapter 1.25"	29.95	Piggyback Bracket f/SCT	CALL
Camera Adapter .96"	27.95	Dew Shields & Dust Covers	CALL
Variable Projection Camera Adapter 1.25"			39.95
#927 45° Erect Image Diagonal Prism .96"			42.95
#928 45° Erect Image Diagonal Prism 1.25"			42.95
#929, #930 2" Mirror Diagonal w/Eyepiece Holder f/1.25"			99.95
Tube Balance Weight System f/All SCT			CALL
531 Motor Drive e/Auto Tracking f/4500 Newtonian			CALL

FILTERS

4 Piece Set 1.25"	49.95	Moon Filter ND96 1.25"	19.95
Individual Filter	14.95	Skylight/Dust Seal	44.95
#905 Variable Polarizer 1.25"			49.95
908 Broadband Nebular 1.25"			79.95
910 Broadband Nebular 2"			119.95
911 Broadband Nebular Rear Cell			99.95
908 Narrowband Nebular 1.25"			89.95
910 Narrowband Nebular 2"			129.95
911 Narrowband Nebular Rear Cell			119.95

JMI JIM'S MOBILE INC.

Next Generation Computers
Motofocus • NGF Focuser
Wheely Bars • Motodec

THOUSAND OAKS

Precision Glass Solar Filters
Mounted Type 2
Mounted Type 2 Plus
Mounted Type 3 Plus

Kowa

77MM SERIES SPOTTING SCOPES

TSN-1	398.95	TSN-3	799.95
TSN-2	379.95	TSN-4	749.95
20-60x Zoom Eyepiece			CALL
800mm & 1200mm Photo Adapter			CALL

82MM SERIES WATERPROOF SPOTTING SCOPES

TSN-821 Angled	CALL	TSN-823 Angled	909.95
TSN-822 Straight	367.95	TSN-824 Straight	CALL
20-60x Eyepiece	CALL	850mm Photo Adpt	CALL
Close-up Adapter (To 4 Meters)			CALL

IF YOU DON'T SEE WHAT YOU WANT... JUST ASK! WE HAVE EVERYTHING TO HELP YOU REACH THE STARS!

MEADE CLOSEOUT SPECIALS

2045s Spotting Scope	$419.95
97E2 Spotting Scope	$399.95
2080/56 Telescope	CALL
2080/50 Telescope	CALL
2080A Telescope *"Perfect For The Beginner"*	CALL
2080B Telescope	CALL
MTS-SN6 Telescope	CALL

MEADE CLOSEOUT SPECIALS

Focus Camera, Inc., 4419-21 13th Ave., Brooklyn, NY 11219 THESE ADVERTISED PRICES ARE VALID SEPT. 1 - SEPT. 31, 1998 SUBJECT TO PRODUCT AVAILABILITY ORDERS ONLY CALL 800-221-0828 • INFORMATION & NY STATE CALL (718)437-8810 Orders ORDER STATUS & CUSTOMER SERVICE (718) 437-8899 • 24-HOUR FAX LINE (718) 437-8810 • STORE INQUIRIES (718) 436-6262. Shipped Promptly - Most Major Credit cards, Money orders & personal checks accepted for payment. COD orders are accepted but may require a deposit, per-

INFORMATION & N.Y. STATE ORDERS

718-437-8810

E-MAIL

orders@focuscamera.com

VISIT OUR WEBSITE FOR DAILY SPECIALS & UPDATES www.focuscamera.com

800-221-0828

CELESTRON

SCHMIDT-CASSEGRAINS

C5+

For astronomy on the go, the C5+ can't be beat. Due to its excellent Schmidt-Cassegrain design and careful crafting, the telescope is a serious, high performance instrument, and its compact size makes it totally portable. The total weight of the C5+, with wedge, is just 23lbs., making it easy to transport.

The C5+ is made in the USA and features Celestron's legendary hand-figured, diffraction limited optical system for optical performance you can depend on. The reputation for excellence of this telescope is such that it was chosen by NASA, over all other competitive models, for several recent space shuttle missions.

C5+ 5", 1250mm f/10	**CALL** *
ULTIMA 2000 8" 2032mm f/10 w/Go To System & Hard Carry Case	**CALL** *
ULTIMA 9 1/4 9 1/4", 2350mm f/10	**CALL** *
Ultima 11 11", 2800mm f/10	**CALL** *
CG 9 1/4 w/Losmandy Mount	**CALL** *
CG 11 11", 2800mm f/10	**CALL** *
CG 14 14", 3910mm f/11	**CALL** *
G-8 8", 2032mm f/10 **NEW!**	**$999.00**
NEW! FASTAR 8 8", 2032mm f/10	**IN STOCK!**

CELESTAR 8 COMPUTERIZED

Engineered for unsurpassed optical performance in an affordable, full featured Schmidt-Cassegrain telescope of large enough apeture to do serious deep-sky observing. This telescope is carefully crafted and manufactured in the USA for dependable quality of the highest caliber. It offers the lowest price ever for a Celestron fork mounted 8" telescope.

The Celestar 8 Computerized comes with factory installed and tested Advanced Astro Master. The Advanced Astro Master pointing system contains a database of over 10,000 objects. Once aligned, it will guide you to any one of these objects.

CELESTAR 8 8", 2032mm f/10	**CALL** **
CELESTAR 8 COMPUTERIZED	**CALL** **
CELESTAR 8 DELUXE	**CALL** *
CELESTAR 8 DLX COMP.	**CALL** *

* **FREE! 2x BARLOW W/PURCHASE**

** **FREE! SHIPPING W/PURCHASE**

(SHIPPING IN THE CONTINENTAL USA ONLY)

CELESTRON CLOSEOUT SPECIALS

GPC-102 ED 102mm (4), 920mm f/9	**$2074.95**
GPC-102 102mm (4), 1000mm f/9.8	**$1149.95**
GP-C8 Mount w/Wood Pod (Demo) #91514-GP	**CALL**
Skyscope 114 (Demo)	**CALL**
C5 Plus #11030 (Demo)	**CALL**
C-8 Plus (Demo)	**CALL**
C5 #11027	**$879.00**
500mm Mirror Lens #81005	**$239.95**

CELESTRON CLOSEOUT SPECIALS

STAR HOPPER DOBSONIAN

4.5"	***FREE GIFT!***	**CALL**
6"	***FREE GIFT!***	**CALL**
8"	***FREE GIFT!***	**CALL**
11"	***FREE GIFT!***	***NEW!***
14"	***FREE GIFT!***	***NEW!***
17.5"	***FREE GIFT!***	***NEW!***

NEWTONIAN TELESCOPES

Firstscope 76 Series 76mm (3")	**CALL** ***
Firstscope 114 Series 114mm (4.5")	**CALL** ***
C114-HD 114mm (4.5"), 900mm f/8	**CALL** **
C150-HD 150mm (6"), 1000mm f/7	**CALL** **

REFRACTOR TELESCOPES

Firstscope 80 Series 80mm (3.1")	**CALL** ***
Firstscope 70 Series 70mm (2.8")	**CALL** ***
Firstscope 60 Series 60mm (2.4")	**CALL** ***
C80-HD 80mm (3.1"), 900mm f/11	**CALL** **
C102-AZ or HD 102mm (4"), 1000mm f/10	**CALL** **

SPOTTING SCOPES

C5 Spotter w/Free T-Mount	**CALL**
Ultima 80	**$349.00**
Rich Field 80	**$299.00**
60mm Zoom	**CALL**
50mm Zoom	**CALL**
30mm Mini Spotter	**$79.00**

TRIPODS & MOUNTS

Lightweight Field Tripod (93591-A)			189.95
Photographic Slow Motion Control			26.95
Photographic Slow Motion Control Deluxe			57.95
Photographic Tripod (93596)	99.95	Vibration Supression Pads	39.95
Heavy Duty Wedge (93655)	239.95	Upgrade Kit f/93655	114.95

ASTRO/CCD PHOTOGRAPHY

CCD Camera PixCel 255	1499	Piggyback Mount 8" & 9 1/4"	34.95
CCD Color Filter Wheel	364.95	Radial Guider	106.95
Digital Setting Circles	CALL	Reducer/Corrector f/6.3	112
Piggyback Counterpoise f/C5	59.95	T-Adapter	CALL

ACCESSORIES

AC Adapter	19.95	Car Battery Adapter	19.95
Case f/C5 & C8 (Most Models)	175	Lens Shades	CALL
Counterweight Bar Assembly 8"	89.95	11"	94.95
DEC Motor f/C5+, Celestar 8, Ultima 9 1/4/11			CALL
Flashlight Red Astro Lite	9.95	Focus Motor	114.95
Flashlight LED	18.95	Motor Drives	CALL
Focus Micrometer, Digital	109.95	Solar Filters	CALL
Hand Controller f/C+, Celestar 8			49.95

FINDERSCOPES

5x24 w/Bracket & Hardware	19.95	Polar Axis Finder w/Illuminator	110
6x30	39.95	6x30 Kit	45.95
7x50	114.95	7x50 w/Pulstar Illuminator	169.95
9x50	69.95	9x50 Kit	89.95

FILTERS

4 Piece Filter Sets	49.95	Moon Filter	19.95	Skylight Filter	44.95
LPR Filter Model B f/Back Threads of SC's					84.95
Polarizing Filter Set 1.25"	42.95	LPR Filter Model A 1.25"			59.95

EYEPIECES & VIEWING ACCESSORIES

Barlow 2x 1.25"	44.95	Barlow 2x .96"	19.95
Barlow 2x 1.25 Ultima	CALL	Barlow 2x .96" Dlx	43.95
Diagonal, Erect Image 45°	39.95	Diagonal, Prism Star	39.95
Diagonal, Erect Image 90°	49.95	Diagonal, Mirror 2"	134.95
Plossl 32, 40mm	57.95	Tele-Extender Dlx	48.95
Plossl 6.3, 7.5, 10, 12.5, 17, 20, 26mm			44
Ultima 1.25" 35, 40mm	104.95	Ultima 1.25" 18, 24, 30mm	84.95
Ultima 1.25" 5, 7.5, 12.5mm			74.95

LV SERIES 1.25"

2.5mm	129	6mm	111.95	12mm	114.95
4mm	119	9mm	112.95	15mm	114.95
5mm	112.95	10mm	109.95	8-24mm Zoom	172.95

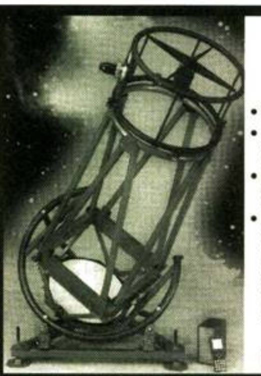
* Other Mounts Avail. Please Inquire

C90 MULTICOATED

#81011

Outfit Includes: 45° Erect Image Diagonal .96", 25mm Eyepiece, Carry Case & T-MOUNT f/PK, FD, MD, YC, AIS, OM, MAX, NIK, EOS*

$374.95



JC524
by L-5 Systems

- 24" f/3.8 Diffraction Limit
- High Speed Go To Capability
- NGC, IGC, Messier Data Base
- LCD Auto Guider, Displays Images on LCD Screen, Overhand Control (Optional)

$19,900

(Shipping & Crating Additional)

TeleVue
"Tops In The Field"

Pronto™

w/2" Mirror Diagonal & 20mm Plossl	***CALL FOR***
w/1.25", 45° Erecting Prism & 20mm Plossl	***BEST***
w/1.25" Mirror Diagonal & 20mm Plossl	***PRICING!***

Ranger

70mm ED SCOPE

Available in Brass or Green

MANY PACKAGES AVAILABLE!

101	***IN STOCK!***
TV-85	***IN STOCK!***

EYEPIECES & BARLOWS

PLOSSL		NAGLER		PANOPTIC	
8mm 1.25"	CALL	4.8mm 1.25"	CALL	15mm 1.25"	CALL
11mm 1.25"	CALL	7mm 1.25"	CALL	19mm 1.25"	CALL
15mm 1.25"	CALL	9mm 2"/1.25"	CALL	22mm 2"/1.25"	CALL
20mm 1.25"	CALL	13mm 2"/1.25"	CALL	27mm 2"	CALL
25mm 1.25"	CALL			35mm 2"	CALL
32mm 1.25"	CALL			Barlow Interface	CALL
40mm 1.25"	CALL				
55mm 2"/1.25"	CALL				

BARLOWS		NAGLER Type 2	
2x 1.25"	CALL	12mm 2"/1.25"	CALL
3x 1.25"	CALL	16mm 2"/1.25"	CALL
2x Big 2"	CALL	20mm 2"	CALL

MOUNTS

Ash Panoramic Mount	CALL
Ash Gibraltar Mount	CALL
Ash Gibraltar & Sky Tour	CALL
Walnut Panoramic Mount	CALL
Walnut Gibraltar Mount	CALL
Walnut Gibraltar & Sky Tour	CALL

ACCESSORIES

Bino Vue Binocular Viewer	*IN STOCK!*
Paracorr Photo/Visual 2" Coma Corrector	CALL
2" Star Diagonal Mirror	CALL
1.25" Star Diagonal Mirror	CALL
1.25" Erecting Prism 45o	CALL
Basic Qwik Point	CALL
Starbeam Projection Finder	CALL
Camera Adapter 1.25" & 2"	CALL
Piggy-Cam Camera Adapter	CALL

Take advantage of our large inventory! Immediate shipment from stock!

sonal checks may require up to 14 days to clear. All orders are subject to verification & acceptance. Shipping, handling & insurance are additional,please call/write for exact details. 14-day money-back guarantee (less shipping) provided merchandise is returned in new condition, unused as received with papers & packaging intact. We gladly accept and reply to written or faxed inquiries. Ad prices available while supplies last. This ad supersedes all previous ads. Focus camera is not responsible for typographical errors.Hours: Mon.-Thurs. 9-7, Fri. 9-2, Sun. 10-6.

STARFEST

Hot, Hot, Hot

STARRY NIGHTS

Pack up the family for a winter trip that won't leave you frostbitten.

by Andrea Gianopoulos

The starry floor, The wat'ry shore, Is given thee 'till the break of day. — William Blake

Leave the five layers of wool and polypropylene at home when you come to the Winter Star Party. Instead, put on a spring jacket and jeans to watch the glow of the winter sky behind the dark silhouette of palm trees. In place of January's arctic winds you'll find subtropical breezes. Instead of a serenade of buzzing mosquitoes, the gentle lull of waves can be heard lapping against the shore. To entice you further, the site boasts sub-arcsecond seeing under reasonably dark skies.

The Winter Star Party is one of the oldest and largest star parties in the United States. Sponsored each year by the Southern Cross Astronomical Society, the event is held at Camp Wesumkee on the Atlantic side of West Summerland Key. This Girl Scout camp is located in a scenic, relatively quiet section of the lower Keys and offers a welcome calm from the hustle and bustle that typifies the region in winter.

BY LAND, SEA, OR AIR

The Florida Keys run some 200 miles from Biscayne National Park in the northeast to the Dry Tortugas in the southwest. Route 1, the artery connecting these slender islands, begins in Florida City just east of Everglades National Park. The Keys begin at Largo, from which Route 1 leads you 106 miles southwest to the city of Key West. A drive along this seaward highway finds shops, hotels, and houses painted in a variety of bright pastels — even the ironic combination of an adobe-style drugstore painted in Pepto-Bismol pink.

Because Route 1 is the only major thoroughfare, travel guides and locals refer to the roadway's "mile markers" when giving directions. These dark green signs dot the right side of the road and can easily guide you to lodgings, restaurants, and attractions. If their numbers are decreasing, you're traveling south toward Key West. If they are increasing, you're on your way north to Key Largo and the mainland. Each sign's number designates how far north the sign is from the Monroe County Courthouse in Key West (mile marker 0).

Warm breezes, palm trees, surf, and sun. The winter star party offers observers more than clear skies and a beautiful horizon. *Astronomy*: Robert Burnham

If flight tickles your fancy, there are two main airports that service the region. The largest is in Key West and is roughly 30 miles from West Summerland Key and the star party. Marathon, in the middle keys, also has an airport. Though not as large as the one in Key West, this smaller facility is only minutes away from Summerland. One word of caution: Flying to this narrow chain of islands can be a bit unnerving. The *cayos*, little islands, are miniature specks of green in a vast sea of blue and turquoise. Though a well-seasoned traveler, from the air I began to wonder how the pilot could possibly land on such a tiny tract of land. My next thought: "If by some chance he does hit the mark, how can there be enough runway to stop the plane?" Yes, I admit to pulling out the safety card from its pocket and hastily glancing over it as the plane approached the runway. Unfortunately, this laminated guide to survival only generated more questions: "Will this hard seat cushion really float, or am I headed down to Davy Jones's locker?"

Kidding aside, from the air, one can truly grasp the fragility of this region. Hurricanes and tidal waves have wracked the Keys for centuries — these hardy islands have hung on for a long time. Even the Spanish explorer Ponce de Leon recognized their tenacity. When historians speak of his 1513 expedition, which brought him to the Keys, they often refer to the name he gave them, Los Martires, the martyrs. To Ponce de Leon, the islands appeared to be brutally tortured — in true inquisitional style — by wind and water.

One of this region's most infamous tortures came on September 2, 1935, when an unnamed hurricane crossed the Matecumb Keys and Islamorada. The tempest's 200-mph winds and 18-foot tidal wave killed more than 1,000 people and destroyed the burgeoning Florida East Coast Railroad. The aftermath of the event is vividly recounted in an essay by Ernest Hemingway ("Who Murdered the Vets?" from *The*

New Masses, 1935) and is a must read for those interested in the islands' history.

The final mode of transportation in the Keys is by water. In fact, it's the only way you can see many offshore sites, including the beautiful seaward reef. Finding a boat is usually no trouble at all. Snorkeling, diving, and fishing excursions abound, and most provide all the gear you'll need. The prices vary and depend on the type of trip you are taking — from all-day angling adventures to two-hour champagne sunset sails.

A particularly interesting underwater site lies near the coast of Key Largo. Here, in 120 feet of water, rests the 327-foot Coast Guard Cutter USS *Duane* and its sister ship the USS *Bibb*. Scuttled in November 1987, these vessels provide an artificial reef environment that lets underwater enthusiasts enjoy swimming with large schools of fish and various types of sponges and corals.

Also found in the waters off Key Largo, near John Pennekamp Coral Reef State Park, is a sunken nine-foot-high replica of Christ of the Abyss. The original, after which this statue was modeled, can be found in the Mediterranean Sea near Genoa, Italy. The bronze figure holds his arms skyward to welcome the phantom souls lost at sea — with some luck, he'll also keep the clouds parted for your evening observing.

OBSERVING BY THE SEA

The skies from West Summerland Key are wonderful. Compared to other islands in the chain, West Summerland is nestled in a relatively undeveloped section of the Keys. To the northeast are Bahia Honda State Park with its sandy beaches and clear, deep waters, and Big Pine Key with its woodlands and endangered Key deer. The southern horizon yields sky views above the gleaming waters of the Atlantic ocean, with only the occasional passing cruise ship producing any light. This comparative lack of commercial development gives Camp Wesumkee darker skies than I had anticipated. The contrast is not as pronounced as the skies of the sparsely populated and dry Southwest, though the winter Milky Way does readily distinguish itself from the skyglow. There also isn't much in the way of twinkling. The high humidity in Florida made me expect a wild frenzy of blinking stars — all appearing to hover like some fleet of those often reported UFOs with rapidly changing light patterns. It was a pleasant surprise to find relatively stable skies.

Accommodations at Camp Wesumkee come in the form of round grass huts called chickees. Each chickee has several bunks, but you need your own bedding (sleeping bag and pillow). Many observers prefer to pitch tents under a canopy of trees near the shore, while others bring along portable homes in the form of trailers and vans. For those who would rather not cook, food is provided by an independent catering service: sandwiches, coffee, and snacks are available until midnight in the camp mess hall. Facilities also include showers.

Those in search of a bit more luxury can select from dozens of resorts, hotels, motels, and B&Bs. If you do stay offsite, you must park your car along the shoulder of Route 1. The camp's main gate closes to vehicles between 7 p.m. and 7 a.m., though you are allowed to come and go as you please provided you have your ticket to reenter. Lighting rules are also strictly enforced. No white light is permitted on the grounds after nightfall.

Daytime activities at Camp Wesumkee include lectures by scientists and die-hard amateurs. There is also a children's program that guides students in a series of daily activities. Some of the 1998 adventures included comparing Earth to a peppercorn, studying Florida fossils, and going for a reef walk at low tide. Isabel Lera, a student teacher and star party volunteer, was popular with the younger set. Each morning students flocked to her tent inquiring about the day's activities, usually toting along every bug, rock, shell, and creature they'd found the evening before. Isabel sparked their curiosity, and it was clear that the children were having a great time while they learned.

Once night falls, southern observers bring out their down parkas, while northerners gleefully put on nothing but windbreakers. For northerners who generally have to practice the time-honored ritual of bundling up in layer upon layer of clothing just to see the Orion Nebula (M42), it's exciting to see winter sky favorites in shirt sleeves and through palm fronds. It's something this Wisconsinite could get used to.

Seeing winter sky favorites under such balmy conditions isn't the only draw. At a latitude of 24°33', many observers come to observe southern sky objects. The billowing clouds of Eta Carinae are a favorite target as is Crux, the Southern Cross. Though these objects were close to the horizon, the steady skies provided us with beautiful views.

Though the skies are relatively steady, they are known to occasionally cloud up. When this happens, many observers head farther south to Margaritaville with its shops, bars, and restaurants.

CONCH TOWN

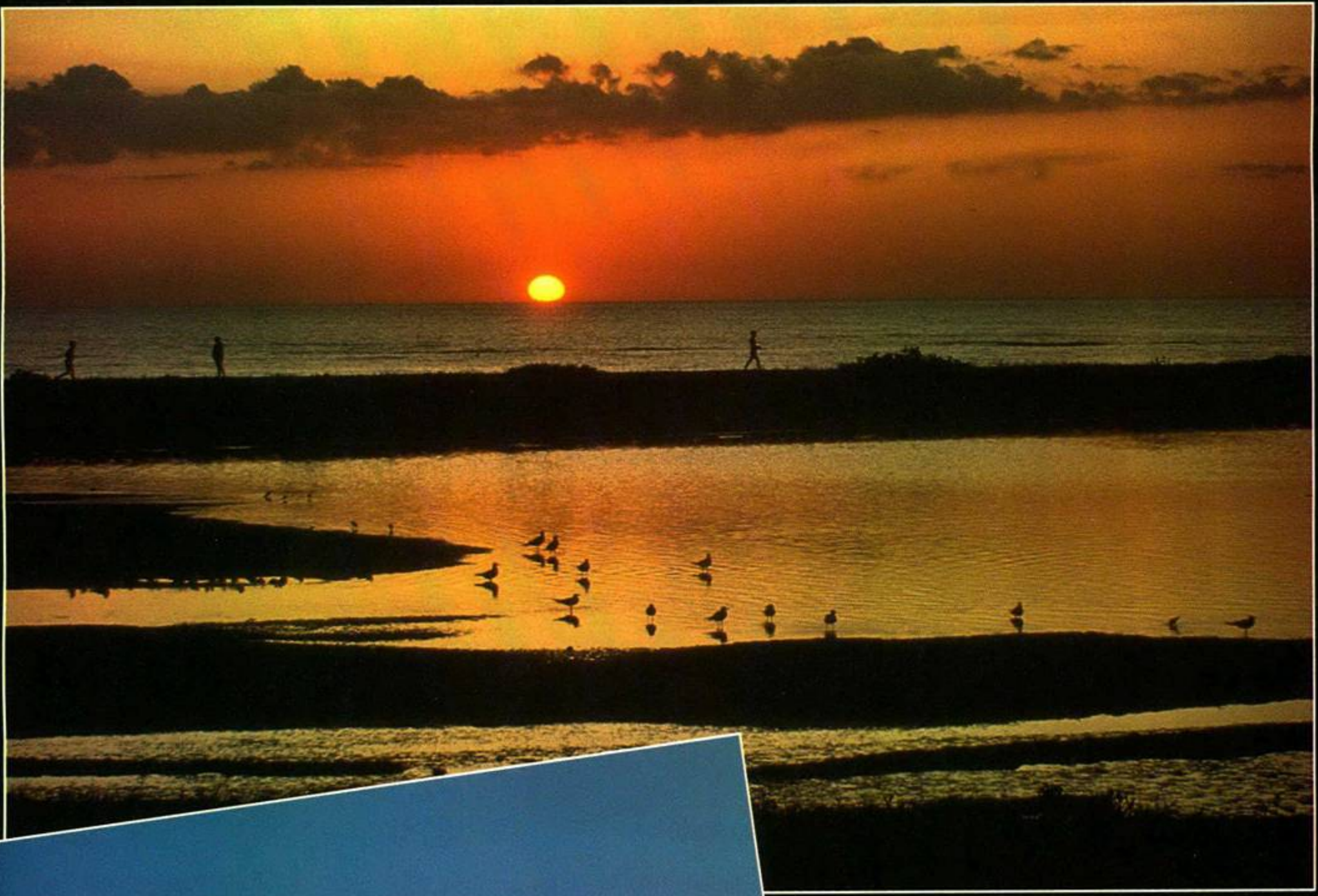
Known to most mainlanders as the town with an attitude all its own, Key West will either charm you or annoy you. A walk down the one-mile main avenue, Duval Street, finds history and wonderful art galleries intermingled with kitsch. One shop deals in handblown glass sculptures from Europe, while its neighbor sells glow-in-the-dark necklaces and Conch Republic T-shirts. Down the street is Ernest Hemingway's house and a courtyard filled with cats — many of which have six toes — while just a few blocks north is Ripley's Believe It or Not Odditorium (maybe the cats should be living there). The town is famous for luring writers and annually hosts a series of successful literary conferences. Hemingway isn't the only author to heed the call of Key West. Truman Capote, Tennessee Williams, Elizabeth Bishop, and John Hersey all took up residence here at some point.

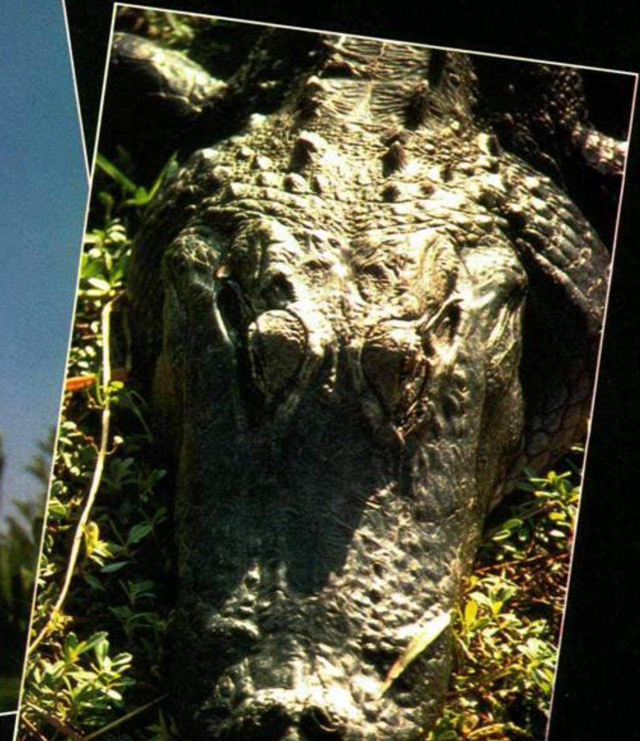
If U.S. history is of more interest to you than literary history, Key West has some of that as well. Here are forts, a presidential residence, and museums to lure the most avid historian. President Truman's Little White House is the most famous historical site in town. Built in 1890, the compound is located in a quiet residential area. Only the cars of residents and their guests are allowed through the iron gates, making this a wonderful place to take a leisurely walk to enjoy the local architecture. Beautiful white homes with intricate "gingerbread" trim and large porches surrounded by exotic plants and flowers epitomize Key West's architectural style.

Another historic site of Key West is Fort Zachary Taylor. This Civil War stronghold was the only fort in the South held continuously by Yankees during the war.

If you're feeling adventuresome, the seven islands of the Dry Tortugas National Park can be found 70 miles from the city. These final links in the island chain offer historical

A gorgeous sunset, a great blue heron, and the ever watchful eye of the alligator — just some of the sights that are waiting in the Florida Keys.
Jeff Weber





MISS VI IAN

TRAVEL THE KEYS ON THE WEB

The following websites can aid you in planning your Winter Star Party adventure.
They will guide you to lodgings, restaurants, and more.

Winter Star Party Information
Southern Cross Astronomical Society
http://www.scas.org

Everglades National Park Home Page
http://www.nps.gov/ever/

Bahia Honda State Park
http://Florida-Keys.infoaccess.com/bahia.htm

Biscayne National Park
http://www.nps.gov/bisc/

Dry Tortugas National Park
http://www.nps.gov/drto/

Florida Keys Activities and Attractions
http://Florida-Keys.info-access.com/Activities.html

Marathon Key
http://fla-keys.com/marathon/index.htm

Key West Paradise
http://www.keywestparadise.com/paradise.html

Best of the Florida Keys
http://www.thefloridakeys.com/

Florida Keys On-line Guide
http://florida-keys.fl.us/

A Guide to the Everglades and 10,000 Islands Florida
http://www.florida-everglades.com/

Diving and Snorkeling the Florida Keys
http://fla-keys.com/diving/about.htm

Florida Keys History Pages
http://www.vtraveler.com/vt/history/history.html

Florida Keys Keynoter Newspaper
http://www.keynoter.com/

Florida Keys Parks
http://www.islandfun.com/parks/parks1.htm

Visit *Astronomy's* website at http://www.astronomy.com for these and other links.

interest as well as scenic beauty. The showpiece of the area is Fort Jefferson, the largest brick fortification ever built. Its eight-foot-thick, 50-foot-high walls appear to rise out of the Gulf of Mexico. Constructed to house a garrison of 1,500 men and 450 cannon, the fort never fired a shot at the enemy. Instead, it became a prison camp housing such notable Lincoln conspirators as Samuel Mudd — the doctor who set the broken leg of President Lincoln's assassin, John Wilkes Booth. The chief activites at Fort Jefferson today are snorkeling and scuba diving.

RIVER OF GRASS

At the opposite end of the Keys is the Everglades National Park — one of the world's true natural wonders. It covers an area of more than 2,300 square miles and is most famous for its alligators, but alligators are only a small part of this biologically diverse ecosystem. To experience the abundance, take time to visit the park's many trails.

One of my favorite treks is the trail to West Lake. Here one can explore the brackish zone of a mangrove forest from an elevated boardwalk. The path rises above a tangled mass of roots and up through the dense canopy. The earthy scents and bird songs are enchanting.

The Mahogany Hammock is another interesting stop, and children will be enthralled with the largest mahogany trees in the United States. When first entering the forest, you immediately notice a temperature drop. The large mahogany trees are dripping with bromeliads and orchids that grow along the horizontal branches. The all too familiar Boston fern prevails here as well — though these ferns are far more lush and green than the poor, scraggly thing clinging to life in the north-facing window of my home.

A palmetto frond shades the sunlight, while star party participants listen for their numbers in the doorprize drawing. Chartered boats abound for those in search of a water adventure. Jeff Weber (top left, lower), *Astronomy*: Robert Burnham (top right)

If alligators are what you seek, a walk along Royal Palm's Anhinga Trail is a must — at least five of these primitive reptiles were spotted on one trip. Most are found curled up in their holes with only the loops of their tails showing. One large monster was sunning himself on a rock. This alligator was not less than 12 feet long from snout to tail and rarely moved. His stillness and steadfast gaze had even the most fidgety children mesmerized.

The Anhinga Trail also offers broad vistas of the "River of Grass." Marjory Stoneman Douglas, who died at a the age of 107 in May of this year, coined the phrase in her 1947 book *The Everglades*. The name describes the area well. The large expanse of waving sawgrass grows in a shallow layer of water that moves slowly toward the sea. Fellow midwesterners will notice the view's similarity to the golden sea of wheat we are accustomed to. The occasional flash of sunlight reflecting off the water is the only reminder of the difference. "There are no other Everglades in the world," Douglas wrote. While pondering those words, an astronomer can't help wondering what it would be like to observe amidst these waterlogged amber waves of grain. Maybe I'll try that on my next trip, provided the alligators behave.

IT'S ALL HERE

Steady skies, warm breezes, unique natural environments, and a colorful history: The Florida Keys have something for everybody. Spend your days exploring the region and your nights exploring the cosmos — all in the breath of a warm tropical breeze. Does this sounds appealing? If so, start planning now. The Winter Star Party has become quite popular, and organizers now distribute tickets via a lottery. The 1999 event is scheduled for February 15–21. Contact Tippy D'Auria by e-mail at 71510.1220@compuserve.com or by phone at (305) 685-6001 for more information. When February rolls around, you will be ready to load up the family and telescope for a week of sun and stars. There is more to Florida than theme parks, and the Keys are just the place to discover it.

Dome Sweet Dome

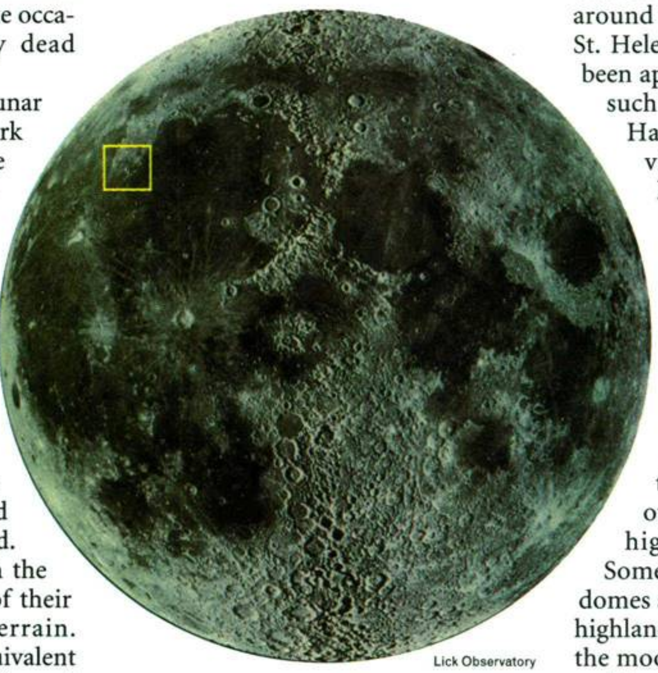
The history of lunar volcanism is more complex than the big, dark puddles of frozen lava that can be seen with the naked eye.

by Jim Bell

WE FELLOW INHABITANTS OF PLANET Earth are frequently reminded of the dynamic, tumultuous, and often devastating effects of volcanism on our geologically active world. However, on our nearest celestial neighbor the story has been quite different. Volcanism on the moon was almost all concentrated early in lunar history, and since then the moon has been, except for the occasional impact, a geologically dead world. Or has it been?

The most obvious effects of lunar volcanism are the bright and dark patches on the moon's surface seen clearly by anyone with good eyesight. Astronomers have long viewed the bright highlands and dark maria as evidence of separate periods of volcanism that produced vastly different geologic features. But a third class of features, lunar domes, suggests these periods may have overlapped — and that the moon may have been fiery and alive much longer than expected.

Lunar volcanism began with the highlands, so named because of their rugged, heavily cratered terrain. Thought to be the battered equivalent of "continents," the highlands formed more than four billion years ago when the moon's surface was still an ocean of hot magma. Higher-density minerals sank into the lower crust and mantle, leaving a residual layer of lighter, lower-density rock on top. A period of calm then preceded creation of the dark puddles of the maria. What looked to some early astronomers like oceans or lakes are actually miles-deep pools of frozen lava, erupted slowly and rather gently through crust pounded thin by huge impacts. Returned Apollo samples and remote sensing studies show that these rocky floods began some four billion years ago and continued until about two billion years ago.



Lick Observatory

Scattered throughout the maria and highlands are discrete, relatively circular hills that remarkably resemble volcanic domes on Earth. These lunar domes usually exhibit heights of a few hundred yards and slopes below five degrees. Many display secondary features such as summit pits or ridges and are often much redder than the surrounding materials. The several hundred lunar domes that have been mapped and studied range in size from less than a mile to more than 22 miles (35 km) in diameter.

On Earth, volcanic domes are most often associated with sticky, viscous extrusions of high-silica (rhyolitic) lava that form steep-sided piles of rock around volcanic vents such as Mount St. Helens. The term "dome" has also been applied to other volcanic features such as the shield volcanoes of the Hawaiian islands, which formed via much more free-flowing, low-silica (basaltic) eruptions. Dome shapes on the moon that resemble both rhyolitic and basaltic domes on Earth have been found in telescopic and spacecraft images. Lunar samples and crater age dating have shown that these lunar domes span a wide range of ages and demonstrate that there may have been substantial overlap between the periods of highlands and mare volcanism. Some studies even point to certain domes as evidence for relatively recent highlands-like extrusive volcanism on the moon.

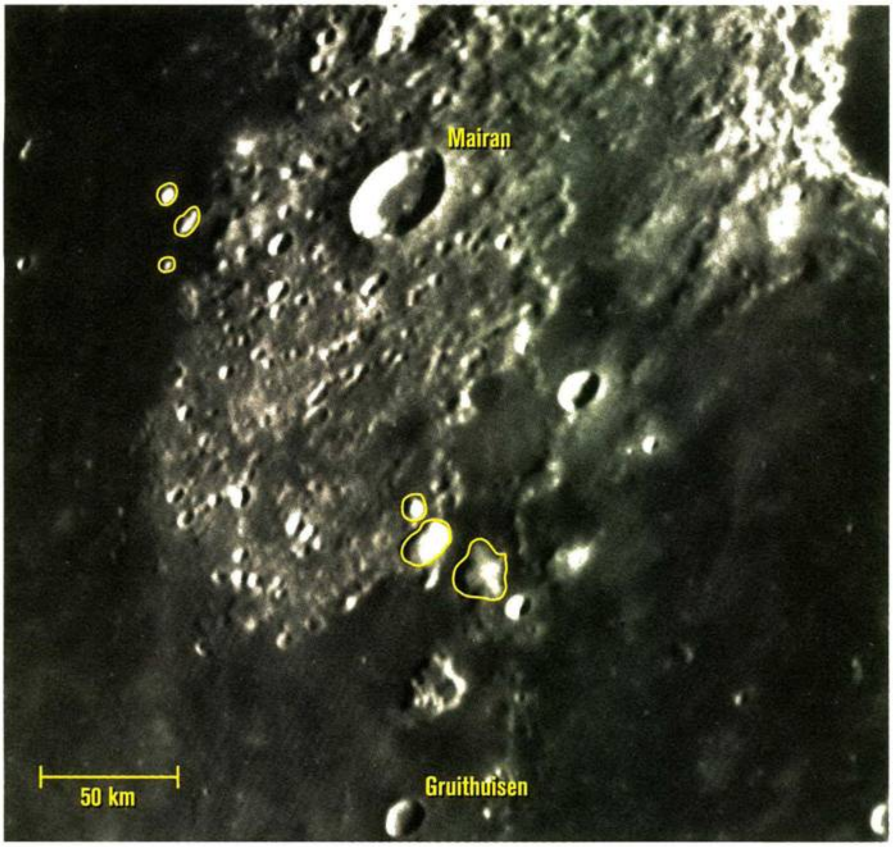
The average lunar dome is around three miles (4.9 km) across, well within the resolution capabilities of most modern amateur telescopes, but unambiguously finding them requires patience, good seeing, and low-sun lighting conditions. Perhaps the greatest concentration of lunar domes, and a good place to start telescopic searches, is near the highlands crater Mairan, 25 miles (40 km) across and about 40 degrees north and 40 degrees west, between Mare Imbrium and Oceanus Procellarum. Three large and prominent domes, ranging up to 7.5 miles (12 km) across and just over half a mile high, can be seen in the mare just west of Mairan.

Another field of three domes lies to the southeast of Mairan, near crater Gruithuisen, 12.4 miles (20 km) across. These domes are more irregular in shape but range up to 20.5 miles (33 km) across and a mile high. The best time to observe these features is just after local sunrise, or about 12 days after new moon. Notice the irregular and furrowed nature of many of the slopes of these domes, and the appearance of summit pits on several of them. Some astronomers believe these domes are just impact-related features formed by the splattering of hills and craters with ejecta from the Mare Imbrium or Sinus Iridum impact events, but their shapes and anomalous colors suggest they are volcanic landforms.

Two more stunning examples of lunar mare domes can be seen two degrees south of crater Cauchy, 7.5 miles (12 km) across, in Mare Tranquillitatis. These circular, 6.2-mile-diameter (10-km) domes have summit pits and may be cinder cones or small shield volcanoes formed during the later stages of mare volcanism. Or perhaps they are anomalous deposits of highlands volcanics, formed during the last desperate gasps of lunar crustal formation. To view these enigmatic landforms, use a high-power eyepiece, set your scope to lunar tracking rates, and time your observing for three to four days after full moon, just as the sun is starting to set in this area. (And while you're in the neighborhood, take some time to explore the spectacular rilles and scarps just to the north and south of Cauchy itself.)

Like the tip of an iceberg or the opening lines of a mystery novel, lunar domes may hint at deeper, internal processes that have shaped the geology and composition of the moon. Studying these challenging features can provide rewarding observational experiences as well as a richer understanding of the complex geologic and volcanic history of our fellow planetary traveler. ◼

Jim Bell is a planetary astronomer at Cornell University and is a frequent telescopic observer of the moon and planets.



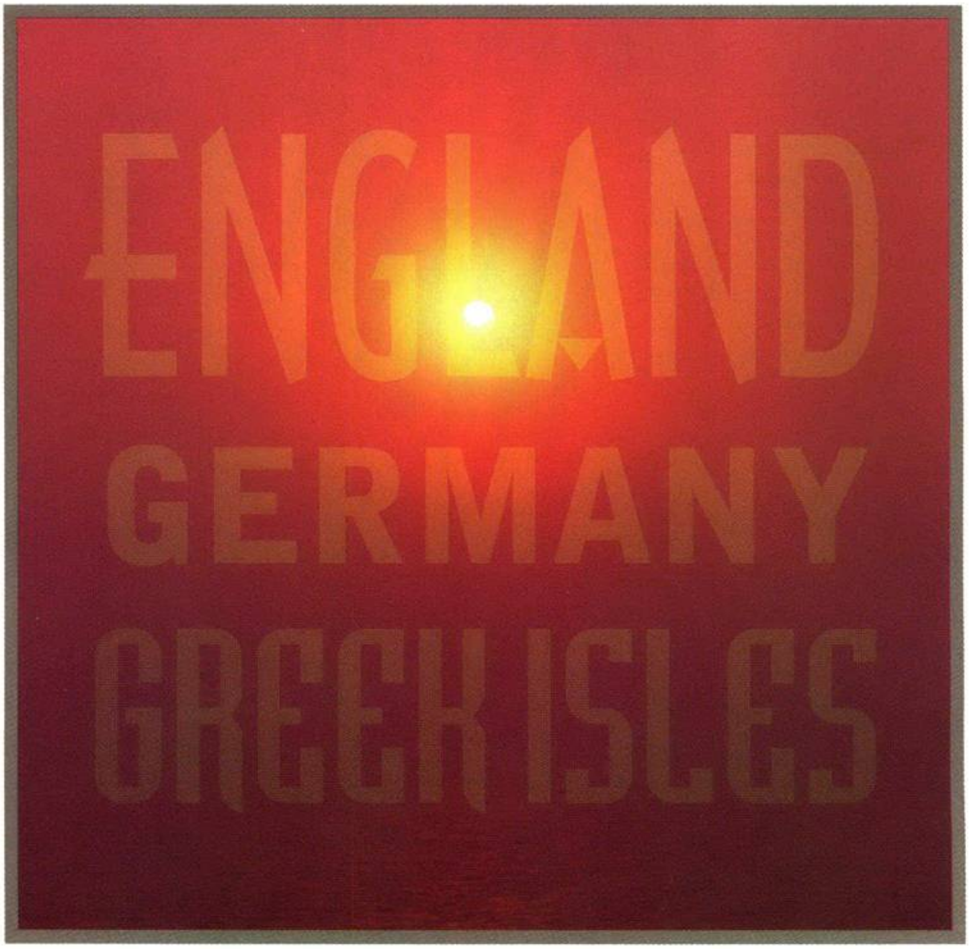
Jim Bell (Cornell University)

A good place to start a telescopic search for lunar domes is near crater Mairan (above), between Mare Imbrium and Oceanus Procellarum (left). The domes' summit pits and furrowed slopes resemble volcanic domes on Earth, such the west flank of Mount Shasta in California (below).

National Oceanic and Atmospheric Administration

Astronomy Magazine presents

1999 solar eclipse tours



Come join ***Astronomy*** Magazine on one of its four amazing solar eclipse tours being held August 6-15, 1999. Along with catching one of the most spectacular views of the last solar eclipse of the 20th century, you will experience the magnificent sights and sounds of such wonderful places as England, Germany, and the Greek Isles in the process. Choose your favorite destination today.

ENGLAND—Visit Stonehenge and Avebury, and be treated to a special evening reception at the Royal Greenwich Observatory. You'll also enjoy a special lecture from astronomy professors at Cambridge, and visits to places such as King Arthur's Camelot, the Battlefield at Sedgemoor, and the home of William Herschel, the man who discovered the planet Uranus, and much more. Both a five-star and three/four-star tour are available.

GERMANY—You'll begin your tour in Munich, the city of festivals, and will help celebrate the special German Festival of the Eclipse. Visit the beautiful Alps, as well as many castles, planetariums, and observatories as you travel along the path of the eclipse.

GREEK ISLES CRUISE—Cruise the ancient coastlines of Greece and Turkey on a 300-passenger ship and view the eclipse from the Black Sea north of Istanbul.

SPACE IS LIMITED SO DON'T DELAY!

For more information call Specialty Tours today at 1.800.677.9412

2785-9810

Simply
out of
this world
Astronomy
Comet
Fever

Order your subscription today!

Call 1-800-446-5489
www.astronomy.com

Astronomy®

The best binoculars for discovering astronomy

Polaris 7x50 FMT-SX

Polaris 16x70 FMT-SX

Fujinon's flat-field POLARIS Series binoculars give you the world's brightest, high-resolution images. *Sky & Telescope* said the 7x50 Polaris was "incredible" and unlike the competition, had longer eye relief and a tripod adapter screw socket. POLARIS distortion-free optics increase the useful field area more than 40% by eliminating defocused star images near the field stop. You enjoy the widest, sharpest and brightest high-contrast views of globular clusters, galaxies and delicate nebulae detail. POLARIS 7x50, 10x70 and 16x70 binoculars are waterproof, meet US Mil Specs and are backed by Fujinon's lifetime limited warranty.

...and finding comets.

Hyakutake, among others, was discovered by Fujinon 25x150 and 40x150 binoculars. They're the largest, most powerful production binoculars in the world. Available with extra low dispersion ED glass, for outstanding color correction, they're also waterproof, built to mil specs and covered by Fujinon's limited lifetime warranty. For more information, contact:

FUJINON INC.
10 High Point Drive
Wayne, NJ 07470
(973) 633-5600 FAX (973) 694-8299

FUJI
FUJINON

New Las Vegas Store, Now Open!

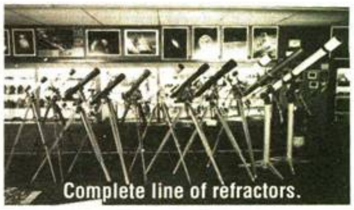
Scope City

Largest, Most Complete Optical Supermarket in the World

Meade Dealer

Parks 10"
f/3.5 & f/13.5
Dual System
H.I.T. Telescope

Complete line of TeleVue products.


Complete line of refractors.

WORLD'S LARGEST SELECTION OF BINOCULARS

SAVE UP TO 45%
ON TELESCOPES, BINOCULARS & ACCESSORIES.
EXPERT HELP.

See the latest innovation in astronomical equipment

MAIN OFFICE
730 Easy St.
Simi Valley, CA 93065
TEL: (805) 522-6646

SHERMAN OAKS, CA
14324 Ventura Blvd.
TEL: (818) 789-5805

SIMI VALLEY
730 Easy St.
TEL: (805) 522-6646

SAN DIEGO, CA
4766 Clairemont Mesa Blvd.
TEL: (619) 277-6686

COSTA MESA, CA
3033 S. Bristol
TEL: (714) 957-6900

LAS VEGAS, NV
4825 W. Flamingo Rd.
TEL: (702) 947-2673

SCOPE CITY / MAIL ORDER
P.O. Box 440 • Simi Valley, CA 93065
TEL: (805) 522-6670
FAX: (805) 582-0292
Catalog package $7 (refundable with purchase).
Free price list.

BUY • SELL • TRADE • SERVICE

ask Astro

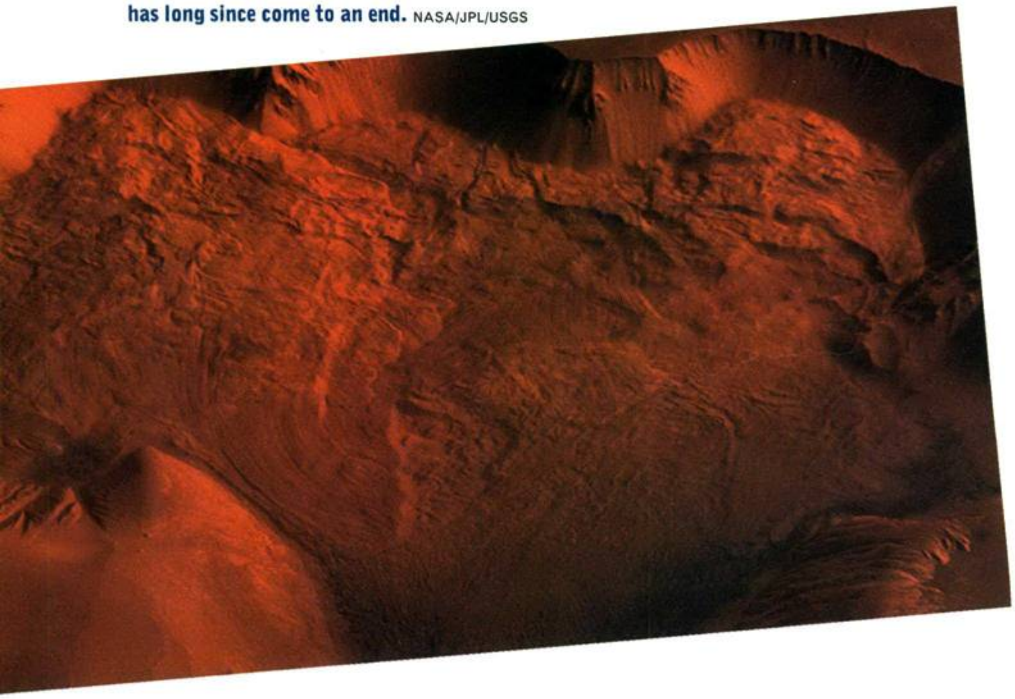
Mars Geology, Galaxy Distances, Light Pollution

Q: If tectonic activity halted on Mars billions of years ago, then why does it still occur on Earth? — *Corry Freeman, Hazleton, Pennsylvania*

A: It's a matter of heat. Earth's internal heat is the engine that drives the motion of the plates across the surface. Heat-driven convection currents from deep in the mantle split the planet's crust apart at places like the mid-Atlantic ridge, forming brand new crust and literally pushing Europe and North America an inch or so farther apart each year. But, as you correctly stated, this type of tectonic activity ground to a halt on Mars billions of years ago.

The reason that Mars has mostly died geologically while Earth keeps chugging along is because Earth's diameter is about twice the size of Mars's. The larger a planet, the greater its ratio of volume to surface area. Heat escapes a body at its surface, so relative to its volume, a small body has a large area that can radiate heat. For example, if you take two marbles of identical composition but different sizes and bake them in an oven to 400° F and then remove them, the smaller marble will cool faster. Because Mars is smaller than Earth, it cooled faster, and therefore it lost the internal heat that drives tectonic activity.

One mystery remains, however. Venus is Earth's twin in size and composition, and yet detailed studies of its topography from the Magellan radar mapping mission don't show much evidence of recent tectonic activity on a global scale. This suggests that other factors, such as the presence of liquid water, also play a role in shaping a planet's geological character. — *Robert Naeye*



This small section of Mars's Vallis Marineris formed when the crust split apart more than 3 billion years ago. But such tectonic activity has long since come to an end. NASA/JPL/USGS

Q: When astronomers look at a galaxy 15 billion light-years away and it's moving away from us at 90 percent the speed of light, how far away is the galaxy from us right now? — *Bob Capone, Reading, Pennsylvania; Rowland Reeves, Auburn, California; Antonio González, Oklahoma City, Oklahoma; Robert Wilson, Tucson, Arizona; Stefan Sabelnik, Trenton, New Jersey; Pat Mahoney, Englewood, Colorado; John Payne, Oakland, New Jersey; and Paul Walorski, Columbus, Indiana*

A: This is a very good question, and it's more complicated than it might seem at first sight. When an astronomer quotes a distance in light-years, he or she is stating the amount of time it took for light to travel from the object to us — the so-called light travel time. So the light we see now from a galaxy 15 billion light-years away left the galaxy 15 billion years ago.

The light travel time depends on what cosmological model is used to do the calculation, because we don't know exactly how old the universe is or how fast it's expanding. For example, if the universe is younger than 15 billion years, we could not observe a galaxy if it took its light more than 15 billion years to get here. Also, because the universe is expanding, the light travel time is not the same thing as the galaxy's distance from us right now. This is because when the light left the galaxy, it was quite a bit closer to us than it is now, and the universe has been expanding during the time that the light has been traveling.

If the universe is 16.5 billion years old, a galaxy that is said to be 15 billion light-years away is actually at a distance of about 30 billion light-years right now. At the time that the light left the object, though, the galaxy was six times closer — only five billion light-years away. — *Chuck Steidel, California Institute of Technology*

Q: What type of lighting emits the least amount of light pollution? — *Peter Blado, Tacoma, Washington*

A: First, use a good lighting fixture, one that is a "full cutoff." That means there is no direct upgoing light at all. It generally also means there is very little light just below the horizontal, which is the kind of light that causes glare. Too many installations produce a lot of glare, and that compromises safety and security, not to mention the blinding obnoxious light. Essentially all lighting manufacturers make good full cutoff fixtures, and there is no excuse not to use them.

Second, use the correct amount of light. Overkill does not help visibility and it can waste a lot of energy. Going from darker areas to overlit areas means the eye does not adapt to the bright areas, and visibility is compromised. Follow the published guidelines of the Illuminating Engineering Society of North America.

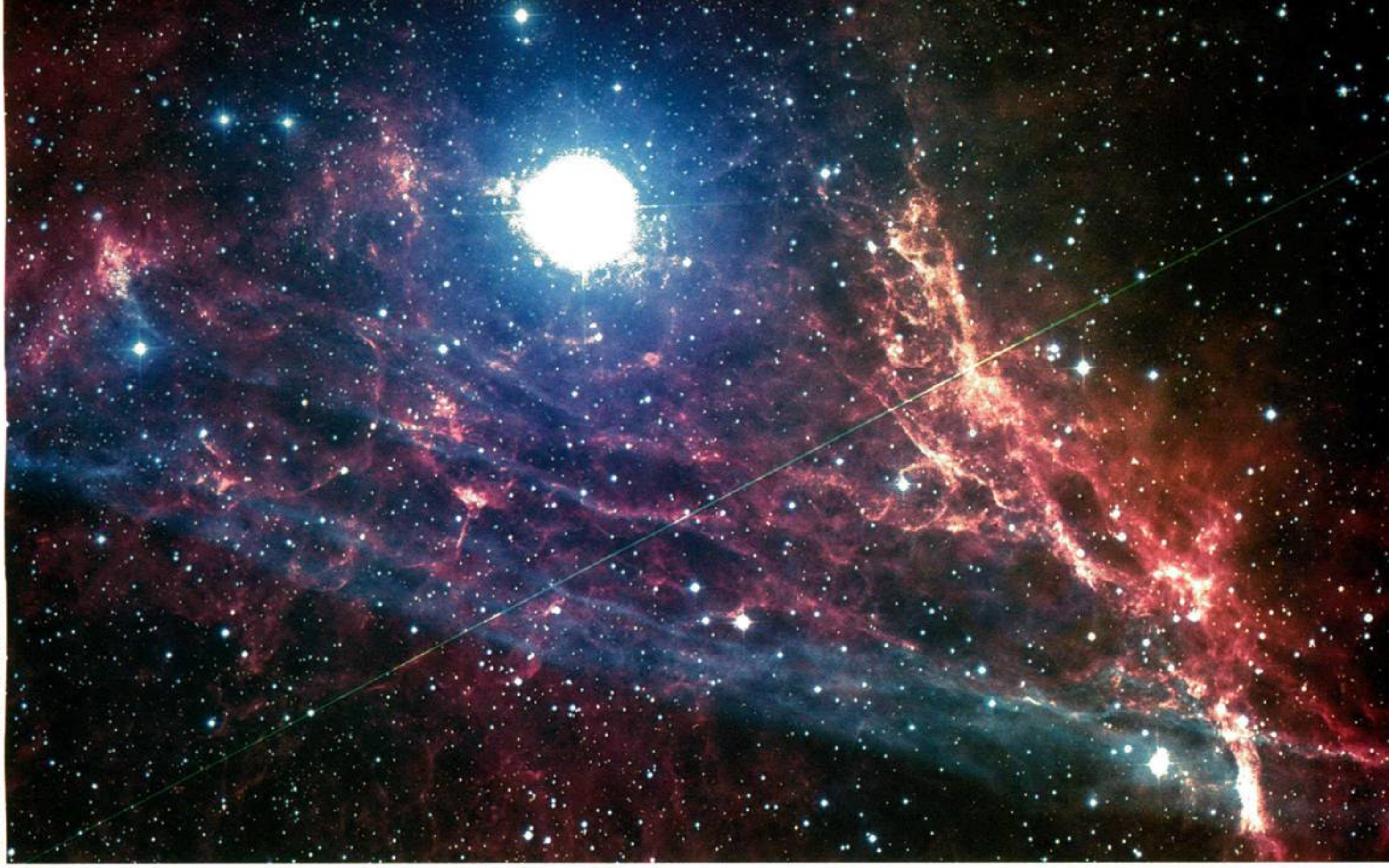
If you have chosen a good light fixture and used the appropriate amount of light, the choice of the light source is less important. In the vicinity of major observatories, and for those who want the maximum energy savings, one should use low pressure sodium (LPS) lights. These lights are essentially monochromatic, so astronomers can filter their emission out, and the sky remains dark at all other wavelengths. LPS is also the most energy-efficient light source. Many astronomers, however, prefer to use high pressure sodium (a sort of amber light) or metal halide (whitish) sources. HPS is fairly energy efficient, and metal halide is the most energy efficient of the white light sources.

Dark skies need our help. Those with additional interest can go to the International Dark-Sky Association (IDA) website (http://www.darksky.org), which has links to other sites, including many in the lighting industry. IDA's mailing address is 3225 N. First Avenue, Tucson, AZ 85719. — *Dave Crawford, Executive Director, IDA*

Q: Is it possible for transuranic elements to form in stars or supernovae, or is uranium the limit? — *Jeramy Russell, Camarillo, California*

A: It is likely that transuranic elements do indeed form, but in such small quantities that they haven't been detected yet. (Transuranic elements are elements heavier than uranium, such as plutonium, that are usually only found on Earth after being created artificially.) The heavy elements thorium (atomic number 90) and uranium (atomic number 92), as well as many lighter ones, are believed to be created in supernovae as atoms in the star's envelope rapidly capture free-floating neutrons. The process makes heavy and very radioactive isotopes whose neutrons quickly decay into protons, increasing the element's atomic number (which is based on the number of protons in the nucleus). Plutonium (atomic number 94) and perhaps even heavier elements can be made in this way.

Plutonium is the only one of these transuranic elements that can exist a fair amount of time before radioactively decaying into lighter elements. It apparently once existed in the solar system, because daughter products of its decay seem to be found in meteorites. — *James Kaler, University of Illinois* ■



Anglo-Australian Telescope Board/David Malin

Supernova remnants such as the Gum Nebula in Vela probably initially contain elements heavier than uranium, but most of these elements quickly decay into lighter elements.

CONTACT INFO

Send your questions via e-mail to: askastro@astronomy.com; or write to: Ask Astro, P.O. Box 1612, Waukesha, WI 53187. Please tell us your full name and where you live. *Astronomy* regrets that due to the large volume of mail, we are unable to publish answers to all questions or respond to each one individually.

LUMICON® ACCESSORIES MEADE® TELESCOPES

TOLL-FREE ORDER LINE 1-800-767-9576 EXPERT INFORMATION 1-925-447-9570 FAX 1-925-447-9589
LUMICON, 2111 Research Drive, Suites 4-5, Livermore, CA 94550 OPEN M-F 9-5, SAT 9-1 PST

LOTS OF ADAPTERS

2" adapter for C-8, Meade 2080, etc.	**$29.50**
2" adapter for C-80, C-100 refractor	**$39.50**
2" adapter for C-70, C-80F, C-100F fluorite	**$39.50**
2" adapter for C-6, Comet Catcher, Meade 312	**$30.00**

EXTENSION TUBES

1" long 1¼" OD thread-in extension	**12.00**
2½" long extension (holds 1¼" filters)	**19.50**
4½" long extension for 1¼" eyepieces	**$29.00**
3" long extension for 2" eyepieces*	**$29.00**
2" long extension for 2" eyepieces*	**$29.00**

VIEWING ADAPTERS

2"/1¼" reducing bushing, threaded 48mm*	**$25.00**
2"/T-thread adapter, threaded 48mm*	**$25.00**
T-thread/1¼" adapter	**$25.00**
F/10 2" or 1¼" eyepiece viewing adapter for Giant Easy-Guider	**$39.50**
Low profile star diagonal eyepiece holder	**$16.00**
Meade 2" Diagonal/Giant Easy-Guider	**$39.50**

**Threaded to hold 48mm filters.*

LED FLASHLIGHT . $14.95

LUMICON LUMILITE™ Red LED Flashlight

This red LED flashlight preserves night vision. Uses 2 AA cells (incl.) which last 60-100 hours.

LUMILITE red LED flashlight	**$14.95**
STARLITE™ adj. red LED flashlight	**$24.95**

RICH FIELD! 2° in 8" SCT

NOW ONLY
$99.95

LUMICON Rich-Field Viewer on C-8 with LUMICON 2" star diagonal and 2" eyepiece.

The LUMICON Rich-Field Viewer fits **all** commercial Schmidt-Cassegrain telescopes. It has a high-performance coated achromatic focal reducing lens with 50mm or 80mm clear aperture for **totally unvignetted viewing** with 2" or 1¼" eyepieces. It is available in several combinations depending on the eyepiece and field-of-view you desire (see chart below).

LUMICON Rich-Field Viewer	**$99.95**
Giant Rich-Field Viewer (10-14")	**$250.00**

Optional Eyepiece	TRUE FIELD	Price
Meade 32mm Plossl	1.4°	**add $99**
Meade 32mm 2" Wide-Field†	1.9°	**add $429**
Meade 40mm 2" Wide-Field†	2.4°	**add $489**

†Includes 2" enhanced aluminum Star Diagonal (may not reach focus on some telescopes).

PENTAX 65° XL EYEPIECES

AMAZING performance! **All have** 20mm eye relief, adjustable helical eye guard, super multicoatings, **E.D. glass**.

5.2mm F.L., 65° Apparent Field 1¼"	**$279**
7mm F.L., 65° Apparent Field 1¼"	**$279**
10.5mm F.L., 65° Apparent Field 1¼"	**$269**
14mm F.L., 65° Apparent Field 1¼"	**$269**
21mm F.L., 65° Apparent Field 1¼"	**$269**
28mm F.L., 55° Apparent Field 1¼"	**$259**
40mm F.L., 65° Apparent Field 2"	**$299**

MEADE 7" - 16" LX200
NEW! 7" - 10" LX50

8" LX50
$1395

16" LX200 $14,950

Meade 8" LX200 Telescopes

LX50 - includes dec. motor, hand controller.
LX200 - full computer control w/64K obj. mem.
Tripod: extra for LX50; included for LX200
NOTE: A wedge is **not** needed for visual observing with the LX200 Drive. Select f/10 or f/6.3 (no extra charge) for your LX200.

NEW! 3.5" f/14 ETX Maksutov ($20)	**$595**
ETX, showroom price *(no 8 month wait)*	**$649**
8" LX10 w/wedge, hand controller ($65)	**$995**
Field Tripod for 8" LX10 ($20 P&S)	**$195**
8" LX50 w/wedge ($115 P&S)	**$1395**
Adj. tripod for 8-10" SCT ($30 P&S)	**$295**
8" LX200 w/computer ($65 P&S)	**$2795**
Wedge for photographing w/8" LX200	**$139**
7" LX50 f/15 Maksutov w/wedge ($125 P&S)	**$1795**
10" LX50, f/10 w/wedge, dec. motor, hand controller ($155 P&S)	**$1695**
10" LX200 w/computer ($155 P&S)	**$3195**
12" LX200 (f/10 only)($215 P&S)	**$4495**
Super Wedge for photogr. w/10",12" LX200	**$395**
16" LX200 f/10 w/tripod ($385 P&S)	**$14,950**
Dew Shields: 8" **$119**; 10"	**$129**
12" **$189**; 16"	**$289**

PHOTOGRAPHY ACCESSORIES

Cassegrain EASY-GUIDER 4"—8", f/6 or f/10	**$249**
Giant EASY-GUIDER for 10"/12" f/4-f/10	**$395**

MEADE STARFINDERS

8" f/6
$749

New 8" f/6 Meade Starfinder telescopes

See the Meade ad in this magazine for full descriptions. These are complete telescope systems with motor drive & finderscope (equat. only), mount, and 25mm (=48X) eyepiece. New DC motor runs on 4AA batteries.

6" f/8 Dobsonian Starfinder ($46 P&S)	**$349**
6" f/8 Equat. Starfinder 6(add $79 P&S)	**$649**
8" f/6 Dobsonian Starfinder (add $59 P&S)	**$449**
8" f/6 Equat. Starfinder 8 (add $89 P&S)	**$749**
10" f/4.5 Dobsonian Starfinder ($85 P&S)	**$599**
10" f/4.5 Equat. Starfinder 10 (add $99 P&S)	**$879**
12.5" f/4.8 Dobsonian Starfinder ($95 P&S)	**$895**
16" f/4.5 Dobsonian Starfinder (freight COD)	**$1195**
16" f/4.5 Starfinder 16 (ship. freight COD)	**$2695**

*All Starfinder telescopes shipped directly from Meade to the purchaser. Please add the indicated packing & shipping charge to the price. Slightly lower P&S for payment by check. LUMICON showroom prices are $50-$100 higher.

ACCESSORIES

LUMICON carries all Meade accessories.

Magellan computer; specify Dob. or Eq. ($15 ship)	**$295**
LUMICON 1¼" UHC or O-III Filter	**$99.50**

Vinyl covers to keep dust-free (2 req.) for 6" - **$10**; for 8" - **$15**; for 10" - **$20**; for 16" - **$35**

SKY VECTOR™ $299!!

Includes Computer, Encoders, Hardware

LUMICON ACCESSORIES

LUMICON, Livermore, CA 94550 (925) 447-9570 FAX (925) 447-9589

LOW PRICE—from $299

LUMICON SKY VECTOR FEATURES:

- "GUIDE" mode leads you to object
- Digital right ascension readout to 1 min.
- Digital decl. readout to 10 arc-min.
- 4000 pulse (0.09° accuracy) encoders
- Polar alignment ***not required!***
- Motor drive ***not required!***
- Just sight two stars to align!
- Works **equally well** for alt-azimuth telescopes like Coulter Odyssey and equatorial mounts like C-8, Meade 2080.
- **No need** to enter latitude, longitude, etc.

SKY VECTOR I™ $299

NEW! With over 220 object memory including the 110 Messier and 58 best NGC objects.

SKY VECTOR II™ $349

Over 3600 objects! — Also includes planets and full visual descriptions.

NGC SKY VECTOR™ $439

12,000 Objects!— PC Serial Port

NGC-Sky Vector™
OFF ON
DIM
MODE
ENTER
UP
DOWN
LUMICON®

NGC SKY VECTOR with IDENTIFY (Sky Tour) mode, 12,000 object memory including the corrected RNGC catalogue, IC catalogue, P&K planetary catalogue, & much more!

Specify Telescope Type: Meade 2045, 2080, 2120, C-8, C-11, Odyssey 8, 10, 13, 17½, Alt-Azimuth, Meade 6-16" Dobsonian.

Ultima 8, 9¼, 11 **add $25**, C-14 **add $75**

COMA CORRECTOR

Coma 1 inch off-axis 17½" f/4.5

Same field with LUMICON coma corrector; smaller, more numerous stars.

This computer-designed LUMICON 2" lens reduces coma and flattens the field for both viewing and photography. **It threads into LUMICON 2" EASY-GUIDERS for effortless installation.** This zero power lens does not change image scale nor shift focus, and all lens surfaces are multi-coated for highest efficiency. Clear aperture = 1.8".

LUMICON 48mm Coma Corrector/Field Flattener Lens	**$285.00**
LUMICON 2" EASY-GUIDER	**$189.50**
2" EASY-GUIDER (Mamiya 645)	**$239.50**
2" Adapter for Pentax 6X7	**$129.00**
2" Adapter for Hasselblad	**$229.00**
2" Adapter for Bronica SQ-A	**$175.00**
2" Extension for viewing	**$26.00**

2" DELUXE BARLOW

1.8x Multiplier Lens (2" Barlow)

LUMICON 1.8x Multiplier Lens (2" Barlow)	**$259.00**

LARGE UV/DUST SEAL

Protect the optics of your 8-14" Schmidt-Cassegrain with a UV/Dust Seal. Simply thread it onto the rear cell, then attach all normal accessories. The large size fits Meade 2120, Celestron-11 and -14 & has a high quality multi coated (removable) 72mm UV filter.

Deep-Sky Filter/Dust Seal for C-8, 2080	**$199.50**
UV/Dust Deal for Celestron C-8	**$39.00**
UV/Dust Seal for Meade 4"—8"	**$39.00**
UV/Dust Seal (lg.) for Meade 10"—12"	**$89.50**
UV/Dust Seal for Celestron-11, -14	**$89.50**

LOW PROFILE FOCUSERS
New! Thread-on for Odyssey

FROM $69.50

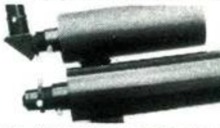
LUMICON® LOW PROFILE FOCUSERS

LUMICON now offers 3 different low-profile helical focusers. They stand only 1¼-1½" above the telescope tube. Use the 1¼" or 2" versions for viewing. Use the 2" non-rotating focuser for convenient photography with the LUMICON 2" EASY-GUIDER™.

Select your desired base-plate shape! Coulter Odyssey (thread-on installation), Flat, 7" OD, 9½" OD, 12½" OD, 16" OD, 21" OD.

LUMICON 1¼" Helical Focuser	**$69.50**
LUMICON 2" Helical Focuser 1½" high	**$75.00**
LUMICON Non-rotating Helical Focuser	**$129.00**
2" Astro Systems focuser, only 2" high	**$139.00**
3 handles for non-rotating focuser	**$12.95**
2"/1¼" **adapter** w/48mm filter threads	**$20.00**
2" LUMICON EASY-GUIDER	**$189.50**

LUMICON 50mm, 80mm SUPER-FINDER™



Visual Astronomers prefer the LUMICON 80mm SUPER-FINDER™, since hundreds of deep-sky objects, including most Messier objects, are visible directly. SUPER-FINDERS also make nice small portable telescopes. 80mm aperture, F=300mm coated achromat or 50mm, F=200mm coated achromat. Eyepieces and/or star diagonal are extra.

1¼" 50mm Finderscope **$69.50**, 45° version	**$69.50**
1¼" straight-thru 80mm SUPER-FINDER	**$199.50**
1¼" right-angle 80mm SUPER-FINDER	**$209.50**
1¼" right-angle version, w/star diagonal	**$239.50**
25mm Cross-hair 1¼" eyepiece (12X)	**$59.00**
Large mounting rings for 80mm Finder	**$55.00**
1¼" Star Diagonal **$49**, Mounting Brackets,	**$39.50**
1¼" 45° diagonal for correct left-right views	**$49.00**

PROTECTIVE DUST COVERS

Protect your valuable telescope optics, eyepieces and accessories with these black vinyl covers. Add $1 shipping. Deduct 10%, 2 or more sets.

1¼" O.D. plug, seals focuser	**4/$2**		
2" O.D. plug	**2/$2**	3½" O.D. plug	**$1.50**
1¼", 1⅜"	**3/$2**	7½"	**$10**
1½"	**2/$2**	9½", 10.4"*	**$15**
2"	**2/$2**	12½", 12⅞"*	**$20**
2⅛"	**2/$20**	15.0", 15.6", 16"*	**$28**
5½"	**$6**	19" (DS-16)	**$35**
*Fits Odyssey		21" (Odyssey-II)	**$35**

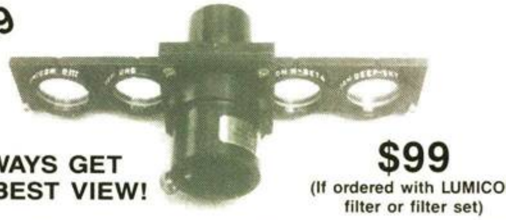
Meade & Celestron
LUMICON carries a full line of telescopes and accessories. Fast Delivery, Competitive Prices.

LUMICON FOR HIGH PERFORMANCE

Visit our LUMICON web-site: http://Astronomy-Mall.com/Lumicon

NEW LUMICON MULTIPLE FILTER SELECTOR

$129



ALWAYS GET THE BEST VIEW!

$99
(If ordered with LUMICON filter or filter set)

The New LUMICON Multiple Filter Selector holds up to 5 1¼" LUMICON filters. The sliding bar has a click-stop at each filter position. Now you can instantly select the best filter for any deep-sky object. Cost is $129 or $185 with 1.5X relay lens (for Newtonians). **Save $30 if ordered with filter(s)!**

LUMICON FILTERS — BEST IN THE WORLD!

"The LUMICON O-III proved to be our favorite... It gave the greatest contrast gain."
***ASTRONOMY*, February 1991**

AMAZING O-III FILTER™

Helix Nebula, NGC 7293 in Aquarius. Bright and easy with Lumicon Oxygen-III Filter.

GREATLY ENHANCED DETAIL

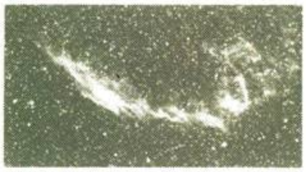
"Consistently performed well on all emission and planetary nebulae. Detail and structure were greatly enhanced in the more than two dozen objects I viewed." ***SKY & TELESCOPE*, July 1995**

BETTER THAN A DARK-SKY SITE!?

"From my light polluted backyard, the view ... was better with the O-III than with any other filter tested. The view was even better than without the filter from a dark-sky site." ***SKY & TELESCOPE*, July 1995**

SEE THE HORSEHEAD!

*"**LUMICON's H-Beta Filter** will show subtle features in emission nebulae that the others fail to reveal. It can't be beat for the elusive Horsehead and California nebulae. . ."* ***SKY & TELESCOPE*, July 1995**



"I CAN SEE THE VEIL NEBULA!"

Rich Zepernick saw the Veil Nebula for the very first time with a **LUMICON UHC Filter**. He stated, *"It was actually there! and not just around 52 Cygni, but the whole loop! Words cannot possibly express my feelings. I don't know how I managed without these filters."*
Rich Zepernick, Cresskill, NJ

DEEP-SKY FILTER™

BEST for Astrophotography!

"Stunning is all I can say," says noted astrophotographer Jack Newton. Great for BOTH color and black and white photography.

BEST WIDE-BAND FILTER!

*"Based on our tests we'd recommend a LUMICON Deep-Sky and Oxygen-III as complementary filters. The LUMICON Deep-Sky Filter clearly had the best contrast for **reflection** nebulae."* ***ASTRONOMY*, February 1991**

	Premium*
1¼" **LUMICON DEEP-SKY Filter** threads into most 1¼" eyepieces	**$99.50**
48mm LUMICON DEEP-SKY Filter (1.7" aperture), threads into most 2" eyepieces. Also fits LUMICON EASY-GUIDERS	**$199.50**
2" LUMICON DEEP-SKY Filter (1.5" aperture), threads into most 2" eyepieces. Also has male & female camera T-threads for prime focus photography	**$199.50**
72mm LUMICON Giant DEEP-SKY Filter (62, 67, 77mm adapter, $10, 82mm $16)	**$399.50**
2" Rear Cell Filter, fits SCT's Deep-Sky, **$199.50** UHC, O-III, H-Beta,	**$199.50**
1¼" LUMICON UHC Filter threads into most 1¼" eyepieces	**$99.50**
48mm LUMICON UHC Filter (1.75" aperture) fits most 2" eyepieces	**$199.50**
Choice of ***any two*** LUMICON filters (**Save 7%**) 1¼" **$185.00**; 48mm	**$370.00**
LUMICON H-BETA Line Filter (9mm bandpass at 486nm). For the California Nebula, Horsehead Nebula, and other extremely faint nebulae. 1¼" **$99.50, 48mm**	**$199.50**
Oxygen-III Filter for very faint planetary and diffuse nebulae, 11nm bandpass at 496nm and 501nm O-III lines 1¼" **$99.50; 48mm**	**$199.50**
LUMICON Comet (Swan band) Filter 1¼" **$99.50; 48mm**	**$199.50**
Telephoto lens adapter for 2" or 48mm filter. Select 46, 49, 52, 55, 58mm	**$7.95**
Universal adapter for 1¼" filters. Adapts the 1¼" filters to any 1¼" eyepiece	**$19.50**
Universal adapter for 48mm or 2" filters. Allows use of any 1¼" eyepiece	**$25.00**

**Premium filters are currently the best in the world. All Lumicon filters include individually measured transmission data.*

TELE VUE™

NEW! Bino Vue Binocular Viewer

5X! Powermate boosts magnification 5X	**$179**
Ranger 70mm f/6.8 apochromat w/45° diag.	**$659**
Pronto 70mm f/6.8 w/45° erecting prism	**$889**
NEW! Bino Vue binocular viewer	**$899**
Gibraltar mount with ash wood tripod	**$535**
8, 11, 15mm Plossl **$95**, 20, 25mm	**$105**
32mm Plossl, widest true field in 1¼"	**$125**
55mm 2" Plossl, widest possible field	**$235**
2.0x or 3.0x Tele Vue Barlow Lens	**$119**
2" Giant Barlow - 2x	**$185**
4.8mm Nagler, 82° field, 1¼" eyepiece	**$175**
7mm Nagler, 1¼" eyepiece, 82° field	**$225**
9mm Nagler, 82° field, 1¼" or 2"	**$245**
13mm Nagler, 82° field, 1¼" or 2"	**$315**
12mm Nagler, Type II, 82°, 1¼"/2"	**$295**
16mm Nagler, Type II, 82°, 1¼"/2"	**$315**
20mm Nagler, Type II, 82°, 2" only	**$395**
2" Paracorr Visual Coma Corrector	**$259**
15mm Panoptic 1¼", 68° field	**$215**
19mm Panoptic 1¼", 68° field	**$245**
22mm Panoptic 1¼"/2", 68°	**$285**
27mm Panoptic 2", 68° field	**$335**
35mm Panoptic 2", 68° field	**$365**

TeleVue Warranty may not be valid outside USA.

NEW! ENHANCED ALUMINUM DIAGONAL MIRRORS BOOST TELESCOPE PERFORMANCE

LUMICON 1.3" & 2.1" enhanced aluminum diagonal mirrors & 1¼" star diagonal.

The new LUMICON diagonal mirrors have a special enhanced aluminum coating with a protective overcoating for long life. Visible reflectivity is 94-96% compared to 86-89% for standard aluminum coated mirrors. The extra 5-10% transmission is like adding up to an inch of aperture! The substrate is fine annealed Pyrex flat to 1/8 wave.

1.32"	**$39.50**	1.52"	**$45.00**	1.83"	**$49.50**
2.14"	**$59.50**	2.60"	**$75.00**	3.10"	**$99.50**

ENHANCED ALUMINUM STAR DIAGONAL

90° star diagonals with 96% reflectivity enhanced aluminum mirrors in a CNC machined black anodized aluminum body. Performance far exceeds prism diagonals.

1¼" (1.32" mirror)	**$99.50**
2" (1.83" mirror)(see photo above)	**$189.50**

ADJUSTABLE PIGGYBACK MOUNT

The LUMICON adjustable piggyback mount is ideal for telescopes of 6-16" aperture. It permits **both** vertical and sideways adjustment for optical alignment. Also ideal to mount LUMICON 80mm SUPER-FINDER™, large telephoto lenses and small telescopes up to about 5 lbs.
LUMICON Adjust. Piggyback Mount $59.50
Specify telescope size: 6", 8", 10", 11", 14", 16"

H-ALPHA PASS FILTER

Yields spectacular contrast gains in B&W photograph with telephoto lenses. Yields pinpoint star images. Superb with hypered 2415. For color, use the LUMICON Deep-Sky (DS) Filter.

Specify Lens Size	H-Alpha	(DS)
46, 48, 49mm	$59.00	$199.50
52, 55, 58, 62mm	$69.00	$199.50
67, 72, 77mm	$79.00	$399.50
82mm (77mm + adapter)	$89.00	$415.00

Hypered 2415 film, 36 exp .. **$11.95, $3/$32**

LUMICON®

2111 Research Dr. #5A, Livermore, CA 94550
For phone orders please call (925) 447-9570
FAX (6 PM-9 AM PST) (925) 447-9589
LUMICON Products catalogue FREE
All foreign orders add 10% ($10 minimum)
California residents add 8.25% tax.
Prices subject to change w/o notice.
Hrs: M-F 9 am - 5 pm, Sat. 9 am - 1 pm

DEEP-SKY ASTROPHOTOGRAPHY

SR-V 3200 NEW FILM

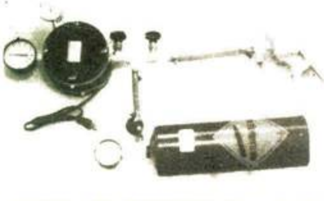
FILM HYPERSENSITIZATION KITS†

LUMICON HYPER-KITS™ yield 3-15x film speed gain in long exposures. They are safe & simple to use. Easy HYPER-KIT includes a chamber with all controls and fittings, thermometer, a refillable cylinder of non-flammable forming gas & hand-operated vacuum pump.

†U.S. Patent 4,473,636

MAKE YOUR OWN HYPERED FILM

MODEL 300 HYPER-KIT sensitizes any 35mm film in hours. Best for 2415. Achieves highest possible film speeds **$325**



MODEL 600 HYPER-KIT (See photo) Like the Model 300, but also sensitizes 120/220 larger format film and small glass plates **$395**

MODEL 1200 HYPER-KIT is for 4X5" plates and film up to 5X7". Has 2 gas cylinders and includes temperature controller ... **$595**

Temperature controller for any HYPER-KIT **$75**

Electric Vacuum Pump, Model R-10 **$325**

GUIDE OFF-AXIS FOR LOVELY ASTROPHOTOS

All **LUMICON EASY-GUIDER™** off-axis guiders† have both radial and 360° rotational adjustments for 5X easier guide-star selection, use 48mm filters, 360° camera rotation, large prisms for bright guide-stars. †U.S. Patent 4,448,500
Specify Camera and Telescope type.

NEWTONIAN EASY-GUIDER™

Full aperture. Installs in seconds. Specify 2" or 1¼".

NEWTONIAN EASY-GUIDER	**$189.50**
48mm Coma corrector/field flattener	**$285**
3X Relay Diagonal (see photo)	**$99.50**
Illuminated reticle eyepiece, pulsed	**$119.50**

Guider for Hasselblad **$489,** Mamiya 645 **$259**
Pentax 6X7 **add $129;** Pentax 645 **add $149**

CASSEGRAIN EASY-GUIDER™

For C-8, Meade 2080, Cynamax-8. Includes 50mm achromatic lens for f/5.8 operation—3X shorter exposures! **Superb rich field viewing, too!**

CASSEGRAIN EASY-GUIDER **$249.00**
Adapter for Hasselblad **$299,** Mamiya 645 **$98**
Pentax 6X7 **add $129;** Pentax 645 **add $149**

GIANT EASY-GUIDER™

For Celestron-11, C-14, and the 10-12" Meade. Includes 80mm clear aperture achromatic lens for edge-to-edge illumination & pin-point star images. F-ratio adjustable f/4-f/11. **Also yields unmatched Rich-Field viewing.**

GIANT EASY-GUIDER **$395.00**
48mm DEEP-SKY Filter ordered with any EASY-GUIDER (SAVE $20) .... **add $179.50**
Adapter for Hasselblad **$399,** Mamiya 645**$149**
Pentax 6X7 **add $139;** Pentax 645 **add $159**

WHAT DO YOU NEED?

1. **Illuminated reticle eyepiece** .... **$119.50** Lumicon 12mm eyepiece system has adjustable LED illumination, dual crosslines, pulsed.
2. **Cable release** for long exposures . **$9.95**
3. **Declination motor** (state telescope type) **$109**
4. **Dual-axis drive corrector** for telescope. This should be part of the telescope when purchased. Call LUMICON for details.
5. **LUMICON EASY-GUIDER** (selection to left)
6. **LUMICON 48mm DEEP-SKY FILTER $199.50** This is essential for highest possible contrast. Contrast is boosted up to 3X for ***both*** color or black & white photos. The 3 photos in this ad showing the Helix Nebula, Horsehead Nebula and Veil Nebula were all made using a LUMICON 48mm DEEP-SKY FILTER.
7. **Hypersensitized film.** Purchase from LUMICON or make your own with a LUMICON HYPER-KIT.

TRY PPF! HYPERSENSITIZED FILM

SR1000
Scotch
1000
TP 135-36

HYPERED FILM IS 2-10X FASTER!

LUMICON Hypersensitized film is essential for good deep-sky astrophotography. Deduct 10% for 3 or more rolls (mixed o.k.). ***No C.O.D.s.***

Film Type, 35mm	Exposures	Price
Kodak PPF-400, THE BEST!	36	**$14.95**
2415, Ultra-fine B&W, red sens.	36	**$11.95**
SR-G3200, fastest of all, color neg	24	**$13.95**
Kodak Gold 1000 fast, fine grain	12	**$13.95**
Fuji G800 fine grain color neg.	**24**	**$13.95**
Ektachrome 1600, fast slide film	24	**$14.95**
Fujichrome RD100, fine grain slide	24	**$12.95**
D-19 B&W Developer	1 gal.	**$8.50**

STAR STUFF

PRODUCTS

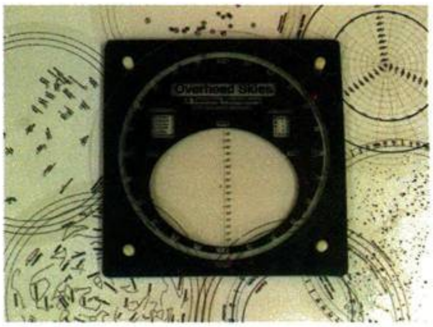
SKY/mount

▶ Basic, but beautiful, Virgo Astronomics is proud to announce the release of its newest product, the *SKY/mount* binocular mount. Featuring the increasingly popular parallelogram design, the mount allows users to keep binoculars aimed at any height. Coated with a black, baked-on, ceramic, scratch-resistant finish and made entirely of aluminum, *SKY/mount* offers the binocular observer answers to any and all of his or her needs at a medium price.

The unit's specially designed binocular platform and harness will hold all types of porro- and roof-prism binoculars up to 50mm. Larger binoculars (up to 80mm) can be attached with an optional Virgo T-bracket or the new SURE/grip holder. The mount also features a unique telescoping shaft, which can be set at either 18 inches or 24 inches to allow greater leverage in determining the position of the five-pound milled steel counterweight. The mount rotates on its own base, and the entire mount can be placed on any heavy-duty tripod assembly.

Virgo Astronomics, 608 Falconbridge Drive, Suite 46, Joppa, MD 21085-4313; phone, (410) 679-7055; fax, (410) 679-2376; e-mail, virgoastronomics@erols.com. *SKY/mount*: $174.95.

Overhead Skies: A Teaching Planisphere



▶ Visits to a planetarium likely spring to mind when classroom teachers consider the best way to teach astronomical concepts. But beset by budget constraints and the complicated logistics of large-scale field trips, those teachers might want to instead try *Overhead Skies: A Teaching Planisphere*, a new product from Angel Enterprises offering many of the advantages of a planetarium at a fraction of the cost. With nothing more than a standard overhead projector, *Overhead Skies* helps teach most of the phenomena displayed in a planetarium, and unlike computer programs, it can be seen easily by everyone in the classroom simultaneously.

Overhead Skies consists of an 11-inch by 11-inch acrylic base plate providing a night sky viewing area. A circular transparent rotating carrier is placed on the base plate, and on top of this the student or instructor places one or more of six circular Mylar overlays. The primary overlay, a typical star field common to all planispheres, includes more than 50 constellations and 500 stars. Five additional overlays, including the constellation patterns, the equatorial coordinate system, the 25 brightest stars, the ecliptic and equator, and selected deep-sky objects, can be used independently or in conjunction with the star field.

Using one or more of the overlays, more than 30 astronomical concepts can be taught, ranging in level from elementary to college age. Also included is a manual with 18 reproducible lesson plans. To obtain a list of concepts that can be taught, check the Angel Enterprise website at http://www.fyi.net/~konvo.

Conceived and designed by Thomas Konvolinka, a 30-year veteran high school planetarium director and college astronomy professor, *Overhead Skies* comes with a base plate, Mylar overlays, a manual, and an easy-to-carry traveling container.

Angel Enterprises, 305 East Beaver Street, Zelienople, PA 16063; phone, (724) 452-6541; website, http://www.fyi.net/; e-mail, konvo@fyi.net. *Overhead Skies: A Teaching Planisphere*: $199.

X-Y Micro-Slides

▶ Recently available from Charles Supper Co., compact X-Y micropositioners that can be attached to the calibration mechanisms of optical equipment allow users to adjust and retain calibrations, making them ideal for fine-tuning positions while observing. The *Supper Series 2201 X-Y Micro-Slides* provide 0.125-inch travel in both planes and are easy to adjust and lock using a six-spline key. Featuring black anodized aluminum sledges with drilled and taped mounting holes, the slides can be mounted most anywhere to facilitate final set-up. The *Supper Series 2201 X-Y Micro-Slides* have permanently lubricated stainless steel drive screws. With a diameter of 0.935 inch and a 0.206-inch thickness, these lightweight slides are available with optional "Z" axis attachments for mounting optics and mirrors.

Charles Supper Company, 15 Tech Circle, Natick, MA 01760; phone, (508) 655-4610; fax, (508) 655-3913; website, http://www.charles-supper.com; e-mail, dg@charles-supper.com. *Supper Series 2201 X-Y Micro-Slides*: $195 each.

Clean Sweep Sale!

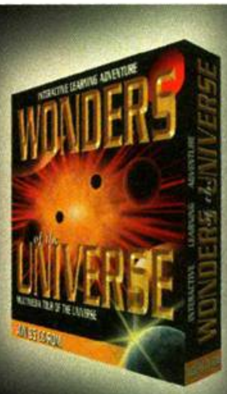
Regular freight and manufacturers' warranties apply.

During our July 1 inventory, we found lots of orphans and discontinued items in our warehouse that need to find new homes. All items are brand new, quantities are very limited, and all are subject to prior sale.

CapellaSoft PC Sky planetarium-view DOS software, \$99.95 list .... **\$59^{50}**
Celestron 8 x 40mm Pro binoculars, \$280.00 list .... **\$99^{00}**
Celestron 7 x 42mm Ultima binoculars, \$360.00 list .... **\$169^{00}**
Celestron 10 x 42mm Ultima binoculars, \$370.00 list .... **\$179^{00}**
Celestron AC Drive for Firstscope 80 refractor and Firstscope 114 Deluxe/Premium reflectors, \$150.00 list .... **\$59^{50}**
Chandler Deep Space 19,000,000 star DOS software, \$129.00 list ... **\$74^{50}**
Edmund 1.25" RKE eyepieces: 8, 12, 15, 21mm, \$49^{95} list ..... **\$37^{50} each**
Edmund Astroscan Tripod Bracket, \$68^{95} list .... **\$49^{95}**
Edmund Astroscan Tote Bag, \$44^{95} list .... **\$32^{50}**
Kendrick AC Adapter for Dew Remover, \$60^{00} list .... **\$44^{50}**
Kendrick 5" Dew Remover, heater cord only, \$45^{00} list .... **\$29^{50}**
Kendrick 6" Dew Remover, heater cord only, \$48^{00} list .... **\$29^{50}**
Kendrick 10" Dew Remover, heater cord only, \$60^{00} list .... **\$38^{50}**
Meade 1.25" 25mm MA eyepiece, \$50 list .... **\$19^{50}**
Meade #635 6x30mm Finderscope, blue, with bracket, \$64 list .... **\$39^{50}**
SBIG ST-6A 400,000 e$^-$ full well CCD camera, \$2650 list .... **\$2099^{00}**
Megastar v3.1 19,000,000 star CD-ROM software, \$129.00 list .... **\$99^{50}**
Swift 8 x 40mm Plover binoculars, \$180.00 list .... **\$79^{50}**
Swift 9 x 63mm Ultralite binoculars, \$745.00 list .... **\$299^{50}**
TeleVue 60mm Solaris Refractor, scope only, \$1995 list .... **\$1195^{00}**
TeleVue Solaris, with DayStar 0.7Å heated T-scanner, \$4570 list ... **\$2749^{00}**
Virtual Reality Labs Software: Mars Explorer, Venus Explorer, Visions of Mars CD-ROMs, \$99.95 list .... **\$29^{95} each**

astronomics

2401 Tee Circle, Suites 105/106, Norman, OK 73069
Toll-Free Order Line: **(800) 422-7876** 24-Hour FAX: **(405) 447-3337**
10 to 8 CST Mon. thru Fri., 12 to 5 Sat. MC, Visa, Discover, Amex.
Restocking fees apply to returns for credit and to merchandise returned in used or damaged condition.


INTERACTIVE LEARNING ADVENTURE
WONDERS of the UNIVERSE
MULTIMEDIA TOUR OF THE UNIVERSE

WONDERS OF THE UNIVERSE

INTERACTIVE CD-ROM

Hundreds of pictures, videos, diagrams, puzzles, and illustrative spoken texts. Patrick Moore takes you through the magnificent story of the universe. Explore the Big Bang, Galaxy Formation, Constellations, the Solar System, the Sun, Planet Earth, and much, much more on this multimedia voyage around the Cosmos.

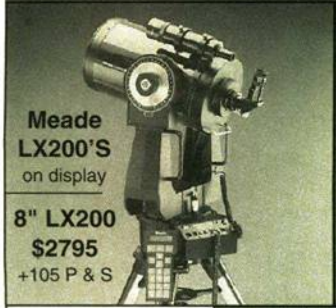
Min. requirements: 486 processor, Win 95, 8 MB RAM, 4xCD-ROM

D-data, Inc., 1 World Trade Center, New York, NY 10048
phone: 212-524-0694, e-mail: d-data.inc@d-data.com
www.d-data.com / www.astro2001.org

Rivers CAMERA SHOP

"Call for our informative catalog"

AUTHORIZED MEADE® APD MAIL-ORDER DEALER



Meade LX200'S on display

8" LX200 \$2795 +105 P & S

Meade 4500 \$399.95 +20 P & S

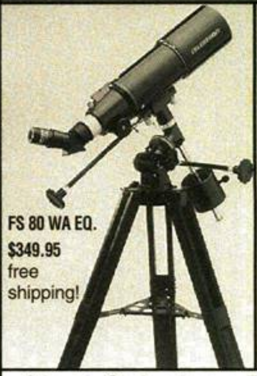
Meade ETX \$595 +20 P & S

ETX accessories
#126 2x barlow \$47.95
#64 Camera Adapter \$29.95
ETX case \$39.95

Most Meade Products in Stock/On Display!

- Meade Starfinder Dobsonians & Equatorials
- Meade LX50's
- 230, 390, 395, 4500's
- Meade Series 3000 and 4000 Eyepieces
- Most other Meade accessories in stock

AUTHORIZED CELESTRON® DEALER



FS 80 WA EQ. \$349.95 free shipping!

Fastar 8 f1.9 imaging system \$2399.00 +95.00 P + S

Most Celestron Products in stock!

- Celestron star hopper Dobsonians
- Celestar 8 SCT's
- Ultima series Eyepieces
- C4.5, FS, 80 + 114

Bright Sky ETX Equatorial Wedge
Mounts to any sturdy tripod.
Functional at all latitudes. \$139.95
Anodized aluminum construction.

Why Buy From Us?

- NE's Largest Telescope Display
- Mail-Order or In-Store. No Sales Tax!
- Used Scopes-Buy, Sell or Trade-In
- Knowledgeable, Helpful, Friendly Staff
- TeleVue®

Rivers CAMERA SHOP
454 Central Ave.
Dover, NH 03820
Phone: (800) 245-7963 • Fax (603) 742-5456
Hours: M-TH 8:30-6:00, Fri. 8:30-8:00, Sat. 8:30-5:30

Paramount GT-1100 Robotic Telescope Mount

▶ Software Bisque, creators of *TheSky* astronomy software, recently introduced the *Paramount GT-1100*, an easy-to-use robotic telescope mount. Its Internet-ready capability lets the *Paramount* provide amateur astronomers with unheard of access to advanced technology for deep-space objects. Pre-programmable operation (known as "scripting") translates into unparalleled productivity, and at less than $10,000, *Paramount* outperforms most anything available to consumers.

Designed for fixed installations, the *Paramount GT-1100* can hold equipment payloads up to 75 pounds. The mount offers several unique features, including Byers 1-inch research-grade right ascension gears to ensure pinpoint stars, telescope modeling software for single-step all-sky pointing to one arcminute or less, one-step park and unpark capabilities so you can start tonight exactly where you left off last night, Internet accessibility allowing you to remotely control the mount, "through-the-mount" wiring for serial- or parallel-type CCD cameras, a dew heater, a focuser and control system to reduce cable clutter, and calibrated altitude and azimuth adjustment screws to simplify polar alignment.

A sophisticated synthesis of electronics and hardware used in concert with a desktop PC (included with the package is Software Bisque's entire Astronomy Software Suite), the *Paramount GT-1100* combines scripted routines, unattended operation, and Internet accessibility to provide staggering productivity, accessibility, and ease of use.

Software Bisque, 912 12th Street, Suite A, Golden, CO 80401; phone, (303) 278-4478; fax, (303) 278-0045; website, http://www.bisque.com; e-mail, danielrb@bisque.com. *Paramount GT-1100 Robotic Telescope Mount*: $9,500 plus shipping.

A BOOKS

The Little Book of the Big Bang: A Cosmic Primer

Craig J. Hogan, 181 pages, Copernicus Press, New York, 1998; ISBN 0-387-98385-6, hardcover, $20

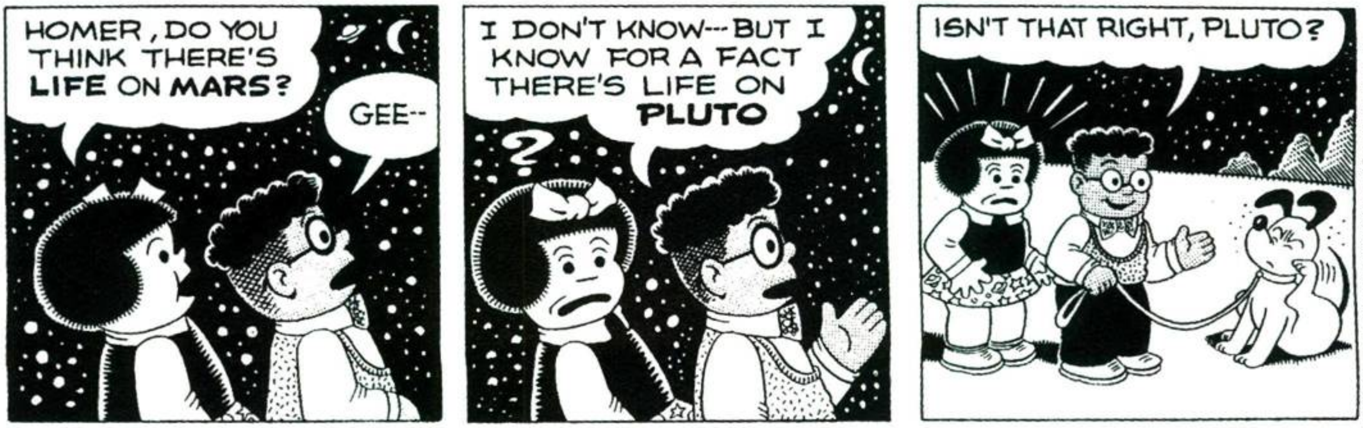
▶ Light and all the matter in the universe filled a dense, hot vacuum no bigger across than a pencil eraser within the first fraction of a second after the Big Bang. Fifteen billion years later, we share a vast landscape with more than one hundred billion observable galaxies.

From an explosive expansion of a tiny speck of unstable space were born stars and moons, fleas and dogs. In *The Little Book of the Big Bang: A Cosmic Primer*, astrophysicist Craig Hogan connects our familiar world with the absolute extremities of the universe.

Hogan tackles questions that have long shrouded the Big Bang in mystery and disbelief: What came before the Big Bang? How did it happen? What is the universe expanding into? Does it have edges? The evidence is all around us if we just know where to look, Hogan tells us. The invisible microwaves that fill interstellar space, for instance, are nothing but cooling light left over from the early universe. But some questions, Hogan says, are not worth posing. Indeed, asking what came before the Big Bang may be something like asking what's north of the North Pole, a place where that direction has no meaning.

Hogan tells us the universe is definite, not infinite, and he sets up his story the same way. Chairman of the Astronomy Department at the University of Washington, his passion is understanding the evolution and structure of the universe. Though he's an expert on the subject, he manages nonetheless to come up with concise, understandable prose for those who aren't. Curious people with little knowledge of the cosmos will be amazed as they begin to grasp the universe. Teachers of astronomy will find simple, compelling ways to explain tough concepts to their students. Astronomers may even learn a thing or two about the story of time and space.

You can consume *The Little Book* like a leisurely evening meal, or you


HOMER, DO YOU THINK THERE'S LIFE ON MARS?
GEE--
I DON'T KNOW--- BUT I KNOW FOR A FACT THERE'S LIFE ON PLUTO
?
ISN'T THAT RIGHT, PLUTO?

NANCY reprinted by permission of United Feature Syndicate, Inc.

When You Buy One of These...

Our
23RD
Year!
ORION
DEEP SPACE EXPLORER
DSE

You Get All of These Too!

Guaranteed Quality

All Orion telescopes and binoculars perform to high standards and are guaranteed to be free of optical and mechanical defects.

A Great Price

We buy most Orion-brand products direct from the factory, so we don't incur a middleman's markup. We pass along the savings to you in the form of low discount prices.

Convenience

Orion products are available from finer optical instrument retailers, or can be purchased directly from our FREE 100-page catalog or our online catalog (www.oriontel.com).

Friendly, Helpful Service

We're the industry experts in outdoor optics. Our friendly Customer Service staff is happy to answer your questions and assist you in selecting the right product for your needs.

Technical Support

We realize you may have questions after you buy too, so we have trained Tech Support reps who are eager to help. Our competitors can't match our level of service and support!

Huge Selection of Available Accessories

We have everything you need to enjoy the hobby to its fullest — from Moon filters to motor drives, eyepieces to observing guides.

Where the Stars Are™ CD-ROM FREE

With the purchase of any Orion astronomical telescope. The perfect guide to the night sky for new telescope users. An $89 value!

Orion. The brand name backed by 23 years of experience serving amateur astronomers.

FREE
$89 Value!

ORION
Where The Stars Are
Astronomy Software
For Windows

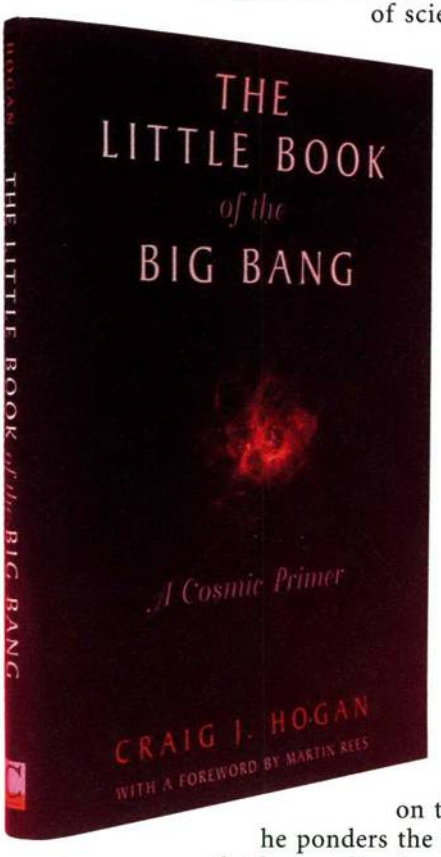
Astronomy CD-ROM

with purchase of any Orion astronomical telescope.

ORION
TELESCOPES & BINOCULARS

Visit us on the Web! **www.oriontel.com**
P.O. Box 1815-A, Santa Cruz, CA 95061
Call Toll Free (800) 447-1001 for a free catalog.

can keep it on the coffee table to snack from. Even slip it into your jacket pocket for a quick fix waiting in line at the grocery store. For people hungry for the full feast, each chapter builds logically to the next. Hogan presents the menu in a chapter called the Big Picture. Appetizers follow in a summary of physics and a survey of space and time. He lays out the sequence of cosmic history from the smallest observable units of space (a length as many times smaller as the width of a human hair as the hair is smaller than the observable universe) up to the largest scale where the entire universe appears uniform.


HOGAN THE LITTLE BOOK of the BIG BANG
THE LITTLE BOOK of the BIG BANG
A Cosmic Primer
CRAIG J. HOGAN
WITH A FOREWORD BY MARTIN REES

The carefully selected main course consists of cosmic background radiation, primordial matter, and the formation of structure. Like a proud chef, he helps us savor their significance by giving us the recipes. Hogan's best ingredients are his simple language and familiar analogies. To describe the power of gravity, for example, imagine skiing down an endless snowy slope. You would at some point reach nearly the speed of light. Hitting a tree at this speed would ignite an explosion the strength of 10,000 nuclear warheads.

Unfortunately for beginners, some bites get a little chewy despite Hogan's effort to simplify. If you're left hungry for details, tables and figures mold information into more palatable morsels. Footnotes qualify assertions and explain certain formulas that might have bogged down his narrative. Devoid of color and serving up only a handful of photographs, the book gets down to business on page one, and stays there. As though predicting such criticisms, Hogan suggest books for further browsing and offers websites for those who crave color photography.

Hogan winds down the main course by going back to the beginning: inflation of the universe from one tiny speck. This is the place where Hogan's personal research most heavily influences his story. Many astronomers are still happy with the traditional notion that an explosion was all it took to send the universe flying apart. But Hogan and an international team of scientists recently reported evidence that repulsive gravity was the cause. Like the host who insists on serving his favorite soufflé regardless of what his guests order, Hogan spends much of a chapter explaining his point of view.

With this one exception, Hogan sticks to the facts and leaves philosophic what-ifs for dessert — a final chapter on the future. Here he ponders the implications of whether we live in a universe customized to our needs or whether only one universe — and only one human outcome — is mathematically possible. In the end, Hogan's answer is like most, "We have no way of knowing." But he's optimistic that even the universe's frigid future should be able to support intelligence in some form.

Whether or not you come away with Hogan's optimism, *The Little Book of the Big Bang* is a painless way to feed your cosmic curiosity. And even if you put the book down feeling like a leap of faith is still all that will convince you, at least you'll have a better idea of what questions are worth asking. — *Sarah Simpson*

Other Books

Moon Missions: Mankind's First Voyage to Another World

William F. Mellberg, 200 pages, Plymouth Press, Vergennes, Vermont, 1997; ISBN 1-882663-12-8; softcover, $19.95.

▶ Breaking some from the "moon book genre" — the tendency of most books written about the Apollo Program to chronicle the experiences of the astronauts who've flown to the moon and the 12 men who walked on its surface — *Moon Missions* instead focuses on the moon itself and describes what those astronauts found.

Broken into three parts, William F. Melberg's book attacks five major questions: why we went to the moon, how we got there, what we found, whether it was worth the cost, and whether we should return. Part One, entitled "The Old Moon," is devoted to a close examination of what we knew and didn't know about our nearest celestial neighbor before the space program. In this chapter we are introduced to some of the visionary figures responsible for dreaming up the idea of reaching the moon, and we are led to understand some of the political factors that ultimately made the trip possible.

In Part Two, "The Moon Missions," Melberg gives careful and complete coverage of the methods and machines used to make the journey. Manned and unmanned, American and Soviet, the moon missions are all described in detail. The third and final chapter offers a valuable round-up of the scientific results of the Apollo Program and how they relate to our current understanding of the solar system. It also carefully examines the benefits — economic, political, scientific, and social — of the race to the moon. The book closes with a consideration of an eventual return to the moon — the justification that can be offered for such a trip and the likelihood of ultimate lunar colonization. Rounding out the chapter is an interesting and thought-provoking discussion of the emerging debate over the mining of helium-3 from lunar soil for use on Earth as fuel for fusion power.

Enhanced by more than 100 original photographs from American and Soviet lunar landings, *Moon Missions*

New! Worldwide Shipping!

Information at www.shutan.com

Meade 102
APO/ACHR-500

Meade
203SC-500

Meade
114/127-500

Meade
EQ Starfinder

Meade
Dobsonian

Many New ETX Accessories Listed Below!

Meade
ETX Astro

Meade
LX10/LX10 DLX

Meade
LX50/LX200

Huge Selection of In-Stock Meade Eyepieces and Accessories!

Made in Japan!

Multi-Coated!

Meade 3000 Eyepieces

Plossl 5, 6.7, 9.5, 16, or 25mm	$50
40mm Plossl	80

Meade 4000 Eyepieces

Super Plossl 6.4, 9.7, 12.4, 15, 20, 26	80
SP32 or 40mm	100
SP56mm	200
Super Wide 13.8	140
Super Wide 18	150
Super Wide 24.5	180
Super Wide 32	240
Super Wide 40	300
Ultra Wide 4.7	170
Ultra Wide 6.7	200
Ultra Wide 8.8	240
Ultra Wide 14	300

ETX 90° Finder Conversion!
$55

ETX Accy s:

Barlow 2x	$50
Case,soft	40
Case, soft deluxe	call
Case, hard	109
Case, hard deluxe	149
Dew shield	26
Digital set circles	389
MotoFocus	99
MotoFocus/Dec	170
Piggyback brkt	60
Prism 45° #932	44
SCT accy adapt	30
Solar filter-glass	69
Tele extender	30
Tripod, adj. field	159
T-adapter #64	30
Visual back 1.25"	30

Meade Barlow Lenses:

#122 2x 1.25"	49
#126 2x 1.25"	49
#127 2-3x 1.25"	60
#140 2x 1.25"	80

LXD500B
EQ Mount
$499.95

Fits ETX, Pronto, Ranger, C90, etc.

Dual-Axis DC
4-Speed Drive
just **$199.95**

Polar Finder
only **$50.00**

Misc. Meade

Accy case 50	$67
AC 541/542	call
Car cord 18 volt	85

Misc. Meade

Car cord 607	$25
Case 7/8/10/12"	call
De-rotator 1220	395
Diagonal 929 2"	100
EP holder 1.25"	25
Epoch 2000 CD	179
Finder 544-8x50	72
Finder 545-8x50	72
Finder 634-6x30	52
Finder brkt-8x50	26
Filter sets of 4	50
Filter ND96 1.25"	18
Focal reducer f:6.3	130
Illum 12mm w/cord	80
Illum 12mm-wless	100
Illum 9mm w/cord	130
Illum 9mm-wless	150
Lenshood 7/8"	114
Lenshood 10"	124
Lenshood 12"	174
Magellan-I/II	call
Motor 531	104
Nebula 908 B	80
Nebula 908 N	90
Nebula 908 O-III	100
Nebula 911 B	100

Misc. Meade

Nebula 911 N	$120
Nebula 911 O-III	150
Off-axis guider	80
Off-axis deluxe	108
Pictor 201XT	399
Pictor 208XT	499
Pictor 216XT	699
Pictor 416XT	1699
Piggy brkt 7/8/10"	34
Piggy bracket 12"	49
Prism 1.25" 90°	43
Prism .96-1.25"	30
Prism 1.25" 45°	43
Skylight/seal	48
Tele extender	30
Tele ext-variable	40
T-adapt: SCT	30
T-adapt: vari-proj	40
T-adapt: 1.25"	30
Vari pol 905	50
Weight set 7"	92
Weight set 8"	92
Weight set 10"	99
Weight set 12"	109
Wedge 8"	134
Wedge Super	399

Book & Star Charts

35 More Books & Descriptions @ www.shutan.com

Astrophotography for the Amateur	168 pgs.	$23
Astrophotography Introduction	192 pgs.	20
Art & Science of CCD Imaging	176 pgs.	40
Bright Star Atlas	36 pgs.	12
Cambridge Guide Stars/Planets	256 pgs.	16
City Astronomy	176 pgs.	19
Deep-Sky Introduction	272 pgs.	25
Messier Album	248 pgs.	22
Meteors	174 pgs.	20
Monthly Star Charts	68 pgs.	25
Practical Guide to CCD Astro.	237 pgs.	31
Phillips Color Star Atlas	40 pgs.	20
Skywatching	285 pgs.	30
Sky Catalog 2000.0 vol.1	704 pgs.	40
Summer Stargazing	64 pgs.	19
Telescopes & Techniques	204 pgs.	26
Turn Left at Orion	205 pgs.	25
Urban Astronomer	224 pgs.	17

WE STOCK 70 DIFFERENT BINOCULARS— CALL!

Lumicon Filters!

Deep Sky • O-III H-Beta • UHC

Misc.

1000 Oaks 1.25" Light Pollution Filters:

B-band/N-band	$90
O-III/H-Beta	90

Schmidling

Easy Tester	30

Rigel

StarLight LED	25

Starbound

Astro Chair	159

Losmandy

DM8 or DC8	90
DM10 or DC11	90
DM12	135
90mm ring set/2	136
108mm ring set/2	160
125mm ring set/2	160
177mm ring set/2	224
DCM mount	80
DCM-1 mount	120

Telrad!

$42

Solar

Solar Filters!

Precision polished **glass,** triple-coated in machined aluminum cell. Image is yellow-orange— no need for secondary filtering!

ETX	$69
5" aperture	79
6" aperture	89
7" aperture	99
8" aperture	99
10" aperture	119
12" aperture	149

Kendrick

Dew Removers

12v Controller	$65
110v adapter	65
Telrad heater	23
1.25" heater	35
2" heater	37
3" heater (ETX)	40
7/8" heater	50
10"/11" heater	60
12" heater	70

Dew Shields!

ETX	26
8"	50
10"	60
12"	85

Kwik Focus!

8"	31
10"	36

JMI

Zero-Image Shift Focusers!

For ALL 8", 10", 12" Meade or Celestron Schmidt-Cassegrains

NGF-S:

w/built-in motor!	**$264**

Eliminates the wiggles!

NGF3 Mini 1.25"	99
NGF DX3 2-inch	159
Leveling wheely bar for Meade 8" or 10" Schmidt-Cass	159
For 12" SCT	199
Keypad holder for LX200's	34

Celestron

Celestar-8	$1099
Celestar-8 Dlx	call
Celestar-8 Comp	call
Celestar-8 DLC	call
Celestar AC	25
Celestar car cord	25

7x50 Ultima	$229
10x50 Ultima	229
8x56 Ultima	269
9x63 Ultima	329
20x80 Deluxe	449
Ultima 9.25	Sale
First 80 AZ	319
WideView 80	249
C5+	call
C5 tripod	239
F:6.3 reducer	130
2x 1.25" Ultima	79
2x 1.25"	50

Pentax

65° Field!

5.2 or 7mm	$279
10.5 or 14mm	269
21mm	269
28mm	259
40mm (2")	279

LX200
Easy-Mount

11.5" x 20"
$98

- A must for 10" LX owners
- Fits 7"-12" Meade scopes
- Bumper-type registration
- 1/4" anodized alum-CNC
- Holds 12 eyepieces!
- Holds keypad securely

TeleVue

TV-101	call
Pronto/Ranger	call
Quick Point	40
Starbeam-T	179
2" 90° diagonal	184
1.25" 90° diag	75
Field Flattener	87
Ext tube 2 or 3"	33
Bino viewer	899
Mounts	call
Up-swing head	100
Paracorr 2"	230
Zoom 8-24mm	219

Plossl-50°

8, 11, or 15	82
20 or 25mm	94
32 or 40mm	114
55mm	229

TeleVue

Panoptic-68°

15mm	$209
19mm	239
22mm	279
27mm	329
35mm	366

Nagler-82°

4.8mm	174
7mm	222
9mm	240
12mm Type2	288
13mm	309
16mm Type2	309
20mm Type2	399

Barlows

1.25" 2x or 3x	109
1.25" **5x** New!	180
Big Barlow **2"**	169

ProStar Eyepiece Cases @ www.shutan.com

Call or visit web site for **FREE 84-Page Discount Buying Guide!** Check or charge card— **ALWAYS** the same low price! Order by **NOON** for same-day shipment. C.O.D. available, inquire. We ship most accessory orders up to 5 lbs. for just **$6.75** via UPS Ground or **$22** 2-Day Air to most **U.S.** addresses. (Worldwide shipping info at www.shutan.com). When in **Chicago,** visit our **3500 square foot** showroom! Shutan is family owned **and** operated since 1918! *All prices subject to change and do not include shipping/handling.*

SHUTAN
camera & video

We welcome bids & PO's from Schools!

Toll-Free 800-621-2248

Illinois Customers 312-332-2000

312 W. Randolph • Chicago • 60606

No Surcharge!

M-F 8:30-5:30
Sat 9:00-5:00

marries an examination of the past with speculation toward the future — and it leaves those of us in the present with an informative and engaging text well worth reading. — *Jeanette Brown*

A BYTES

Mercury CD-ROM

▶ With more than 360 high resolution images of the planet Mercury acquired from the Mariner 10 mission of 1974, the *Mercury CD* two-disc set is the most complete collection of Mercury images available. The Mariner 10 mission is the only mission ever to go to Mercury, and its primary purpose was to image the planet. High resolution images of Mercury have since become increasingly rare because soon after the completion of the Mariner 10 mission, the Viking landers and orbiters successfully landed on Mars and martian imagery became the principle focus for NASA.

The majority of the images featured on the *Mercury CD* set are between six and 10 megabytes each and are in tiff format. The images each concentrate on five-foot-square surface areas and reveal extraordinary detail. Most have never before been seen by the public and are available nowhere else on CD-ROM. The quality of the images provided coupled with the fact that they are images previously inaccessible to the general public will undoubtedly make this CD-ROM an important addition to your CD library.

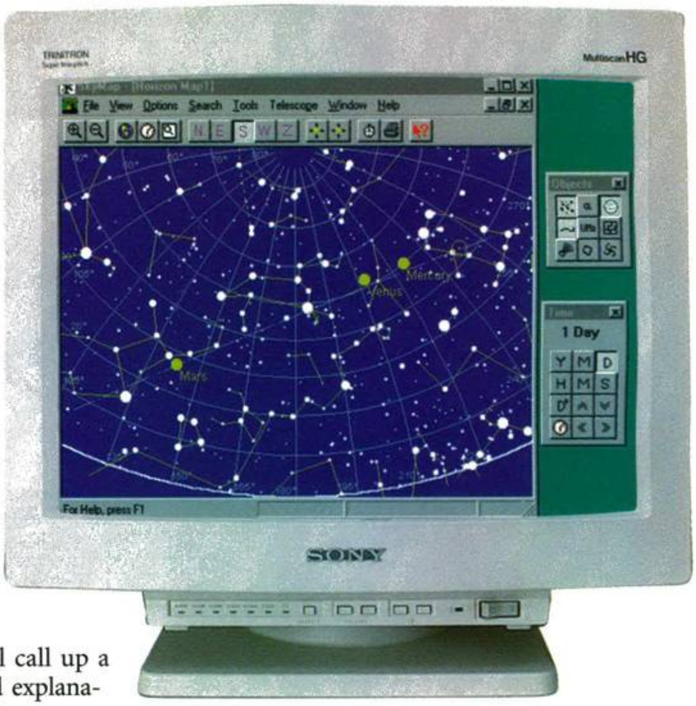
Nick Marella Publishing, 836 Northwood Avenue, Cherry Hill, NJ 08002; telephone, (800) 292-1414; e-mail, 102524.1520@compuserve.com. Price: $124.95 plus $4.95 shipping and handling. Minimum requirements: Mac/PC Windows 3.0, 3.1, or 95, 386 processor, 8 MB RAM, CD-ROM drive.

TryOrbit

▶ "Test drive the highways of space," tempts its manufacturers. If you want to understand the dynamics of travel in outer space but are intimidated by astronomical texts, try out *TryOrbit*. With a hands-on approach, *TryOrbit* lets you learn and explore while generating a variety of cislunar orbits. Each orbit you generate will display an animated two-dimensional orbit simulation, a detailed listing of each orbit's parameters, three angles of orbit calculated for 360 intervals of time, two graphs of satellite speeds at various orbital positions, and much more. An accompanying text document, "Learning about Orbits," will provide full descriptions for dozens of orbital dynamic equations. A single click of the mouse will call up a concise, straightforward explanation of any program feature or astronomical term. Covering more than 450 topics and providing more than 50 graphic illustrations, "Learning about Orbits" will transform difficult astronomical concepts into familiar easy-to-understand ideas.

TryOrbit is a useful tool for more than just beginners too. People whose jobs put them in contact with aerospace companies, satellites, or telecommunications, those seeking a hands-on familiarity with the basic tools of space exploration and the economic potential for space industrialization, or even science fiction authors who want to authenticate their scenes and plot lines — all will benefit from the program. Its additional features include the capability to solve Kepler's equation for any possible elliptic orbit, including comet-like flight paths, a database utility for storing and reviewing your custom orbits, and copy and paste functions that let you paste text, graphs, or listed output into Windows word processing, paint, or spreadsheet applications.

Psignologic Services, #101-1001 W. Broadway, Suite 764, Vancouver, B. C., V6H 4E4, Canada; e-mail, timer@axionet.com. Minimum requirements: 386 processor, Windows 95 or NT, VGA monitor, 4 MB RAM for Windows 95 or 8 MB RAM for Windows NT, 7.5 MB hard drive space.



The Webweaver Picks

With the wave of impact disaster movies providing grist for the Hollywood movie mill, here are some selected impact sites for your perusal.

Asteroid 1997 XF11 (Earth Close-Approach)
http://ssd.jpl.nasa.gov/ca_97xf11.html

IAU's List of Predicted Close Approaches
http://cfa-www.harvard.edu/iau/lists/CloseApp.html

NASA Ames Asteroid and Comet Impact Hazards
http://impact.arc.nasa.gov/index.html

Sandia National Labs Comet-Impact Site
http://www.sandia.gov/1431/COMETw.html

Solar System Collision Calculater
http://janus.astro.umd.edu/astro/impact.html

Terrestrial Impact Craters
http://www.hawastsoc.org/solar/eng/tercrate.htm

PRODUCT INFO

Astronomy assumes no responsibility for the product information supplied by manufacturers. Prices are retail and subject to change without notice. Suppliers should send announcements and color photographs to Star Stuff, P.O. Box 1612, Waukesha, WI 53187, or e-mail starstuff@astronomy.com. Check *Astronomy*'s website for news as it happens — http://www.astronomy.com

TUTHILL,
YOUR ASTRONOMICAL FRIEND SAYS

Start now to watch and photograph Sun Spots as they grow toward the next Solar Maximum with our SOLAR SKREEN® Sun Filter on your finder, binoculars or telescope.

SOLAR SKREEN® FILTERS give sharper images of even the smallest Sun Spots than window glass solar filters. Send a large (9x12") SASE envelope (4 stamps) for a FREE sample of SOLAR SKREEN®.

Call 800-223-1063 for details of the
SOLAR SKREEN® CHALLENGE
Roger W. Tuthill, 11 Tanglewood Ln., BX
Mountainside, NJ 07092

PRICES TOO LOW TO PRINT!

Any other legitimate listed prices will be bested.
Special - 90 mm EQ $390

MEADE

DOBSONIANS
REFRACTORS
REFLECTORS
SCHMIDT-MAKS
ALL ACCESORIES

SCH/CASS 8" f/6.3 Computer $1995; Schmidt/NET f/5 $599; Barlow Lens 3X $49; Nebular Filters from $49; Counterweight Assy $39; Piggy Back Bracket from $21; Filter (.96) (4 set) $33; Photo Guide Bracket $29; Finderscope Bracket from $12; Finderscopes from $19; Deluxe Latitude Adj. $21; Compass for SCH/CASS $10; and much more!

CELESTRON

TELESCOPES

8" Schmidt-Cassegrain OTA $695

BINOCULARS
SPOTTING SCOPES
ACCESSORIES-
THE COMPLETE LINE

Apogee • Bausch & Lomb • Criterion • Bushnell • Jason • Brandon • Vernonscope • Losmandy • Swift • Fujinon • Kowa • JMI • 1000 Oaks • JMB • Astro Systems • Parks Optical • And More!

IMPORT - EXPORT
A WORLD CLASS DISTRIBUTOR TO INDUSTRY- GOVERNMENT- PRIVATE AND PUBLIC EDUCATIONAL INSTITUTIONS.
RETAIL- WHOLESALE ACCOUNTS
BUYING SEVICES WELCOMED

Filters 1$^{1/4}$ (4) for $33

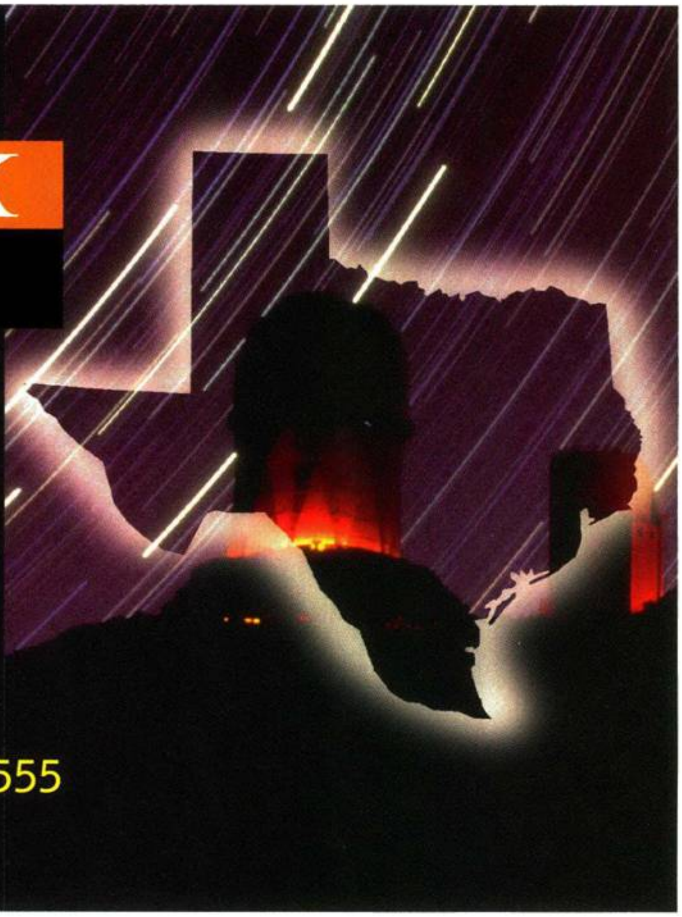
WWW. ASTROPTX.COM

• PUBLIC WELCOMED • NO SALES TAX COLLECTED
• SHOWROOM: 57 NORTH STREET/ SUITE 401, DANBURY, CT 06810
• PHONE ORDERS 9AM-MIDNIGHT (7) DAYS A WEEK
JCB **E-Mail: astroptx@astroptx.com**
SEE FULL PAGE AD IN JULY ISSUE PAGE # 103

WHOLESALE OPTICS DIVISION
59 MINE HILL ROAD. NEW MILFORD, CT 06776
Tel: (860) 355-3132
CATALOG $10 (REFUNDABLE WITH PURCHASE)
****LOWEST PRICE GUARANTEE****

Oklahoma City Astronomy Club and *Astronomy* Magazine present

OKIE◆TEX
Star Party



Plan on coming
OCTOBER 18–25
at Prude Ranch in Fort Davis, Texas!

REGISTER NOW!
Online – www.icon.net/~seadkins/okie-tex.html
Call – 405-681-8783 (Star party registrations only)

For hotels, car rentals, airfare, and area attractions, call Specialty Tours

1-800-677-9412 or **813-796-7555**
Ask about the special Star Party Wilderness Package!

2605-9809

Astronomy's Marketplace

Welcome to the MARKETPLACE section in ASTRONOMY Magazine. These pages are specifically designed to be an affordable and highly effective way for you to market astronomy-related products or services. Call Michael Ellis at 888-558-1544, ext. 636 to place your advertising message here.

T & T Binocular Mounts & Beyond, LLC

Super Side Mount

Designed for comfort it can be used standing or sitting with ease. The heavy duty central towers and stabilized friction plate allow one handed operation while holding even the heaviest 100mm binocuars. $180.00 plus applicable tax, S & H.

Call or write:
18 Strong St. Extension, East Haven, CT. 06512
(203) 469-2845 or (203) 272-1915

R3
SEYCHELLES

HALLEY'S COMET ON STAMPS

DOUGLAS COOK, INC.
P.O. Box 94198 Dept. AT-10
Las Vegas NV 89193
Ph: 702-795-7400
Fax: 702-795-2794
send $1.00 for lists
(refundable with order)
or visit our web site
http://dci.tierranet.com

Solar Eclipse Cruise '99

Aboard Norwegian's newest ship, the *Norwegian Sky!* Join Astrophysicist Joseph Gurman, Ph.D. on a cruise of a life time! Joseph Gurman has vast experience in solar and stellar chromospheres and can offer an excellent perspective on viewing and experiencing this natural wonder.

The new *Norwegian Sky* will sail on August 9 , 1999 and visit London, England; Cherbourg, France; Solar Eclipse-Observation site at sea is 10:11UT 50 - 9.2' N, 6 - 5.1' W Totality 2:01; Dublin, Ireland; Glasgow, Scotland; Bergen, Norway; Oslo, Norway; and Amsterdam, Netherlands!

This wonderful 10 night cruise starts at $2995.00 per person and includes port taxes. Early booking special will include 2 nights in London! For a brochure and more information call:

All Aboard Travel
1-800-741-1770
www.allaboardtravel.com

SETIQuest.

Request Your Free Sample Issue!

Join fellow astronomers in the quest for evidence of life in the universe.

SETIQuest is a quarterly magazine devoted to the Search for Extraterrestrial Intelligence (SETI) and bioastronomy. Read timely accounts of new discoveries, review pertinent articles in astronomical publications, scan scholarly overviews on the origin of life and exobiology, and gain insight into current observational strategies.

***SETIQuest* Inquiries, Dept.AS • 174 Concord Street • Peterborough, NH 03458-0874**
603-924-9631 • Fax **603-924-6746** • E-mail **seti-circ@helmers.com**

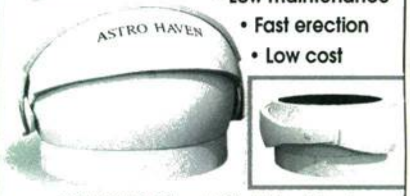
Visit us on the Web at http://www.setiquest.com

ASTRO HAVEN

FULL 180° VIEWING RADIUS

NON-ROTATING CLAMSHELL DOMES

- 7' or 12' diameter
- Low maintenance
- Fast erection
- Low cost



#303-2450 Church St. Abbotsford
British Columbia, Canada V2T 3J7
Fax/Phone (604) 859-8982

JOIN US IN CELEBRATION OF

THE 1999 SOLAR ECLIPSE

AS WE CRUISE THE LAST
SOLAR ECLIPSE OF THE 20TH CENTURY

ABOARD PRINCESS CRUISE LINE'S

ROYAL PRINCESS

This magnificent ship will set sail on August 10, 1999 for a 13 day voyage of SCANDINANIA/RUSSIA.

We will sail round-trip from Dover, England to:
LE HAVRECOPENHAGEN ***STOCKHOLM***
HELSINKI ***ST. PETERSBURG***
TALLIN ***OSLO***

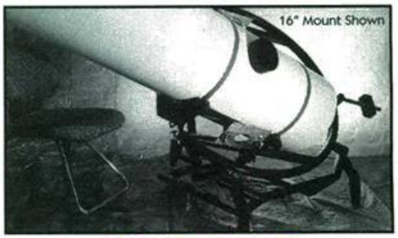
Princess Cruises will be **featuring on-board eclipse and astronomy presentations.**

CRUISE HOLIDAYS®

For Details Please Call
1-800-955-5769

1605 N. Wilmot Rd., Suite 102-B • Tucson, AZ 85712

UPGRADE YOUR DOB



SPLIT RING EQUATORIAL MOUNT

- DESIGNED FOR DOB OPTICAL TUBES
- BALL BEARING R.A. MOVEMENT
- LARGE NYLON DEC. BEARINGS
- R.A. & DEC. BRAKES
- 360° EYEPIECE ROTATION
- ADJUSTABLE TRIPOD BASE
- FOLDS FLAT
- ACCEPTS NON DOB OPTICAL TUBES
- OFFERS STIFFNESS & LIGHT WEIGHT ONLY AVAILABLE IN A SPLIT RING

8" $249.00	12" $499.00	16" $749.00
S&H $55	S&H $75	S&H $95

TWO YEAR WARRANTY-30 DAY MONEY BACK SATISFACTION GUARANTEE

STANLEY DEVELOPMENT CO.
P.O. BOX 21034 BARRIE, ON L4M 6J1
Ph. (705)739-1848 FAX (705)739-1649

PHONE, FAX OR WRITE FOR SPEC. SHEET & ORDER FORM

PORTA-DOME
(Portable Observatory)

FEATURES
•GREATLY REDUCES STRAY LIGHT
•PROVIDES A WIND BREAK
•ROTATES 360 DEGREES
•STABLE STEEL FRAME
•SLEEPS 2 COMFORTABLY BESIDE YOUR SCOPE!

Winner of Universe 98's Raffle, Bill Fjord is impressed with his new Porta-Dome & the 40+ mph winds it *withstood*, with no damage! It really is a Stargazers Haven!

$1445 + S&H

J.A.S.E.N. Ent.
3983 Highland Ave., Benton Harbor, MI 49022
Ph: (616) 944-3413 Fax: (616) 944-5733
Email: ellensue@Parrett.net

STAR SPECTROSCOPES

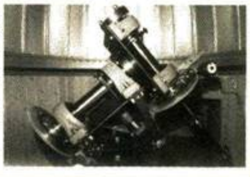
Visual Star Spectroscope	$ 149
Visual/Photo/CCD Model	$ 199
NEW! Nebula-Seeking Filter	$ 129

RAINBOW OPTICS
Free Information: (510) 581-8266
1593 "E" Street, Hayward, CA 94541

METEORITES
Michael I. Casper, Meteorites, Inc.
Post Office Drawer J
Ithaca, New York 14851 U.S.A.
Phone: 607-257-5349 Fax 607-266-7904
e-mail: casper@meteorites.com
http://www.meteorites.com

OPTIC-CRAFT MACHINING
33918 Macomb, Farmington, MI 48335 • 248-476-5893
Builder of Precision Clock Drives & Equatorial Mountings

Optic-Craft Machining has been creating precision clock drives & mountings worldwide for 23 years. Our drives feature full-surface variable clutches, 100% gear mesh, minimum 1,300-ft-lb torque, in a complete unitized assembly. Motors A.C. synchronous & D.C. stepper. Drive models 6.6" $455, 9.0" $540 up to 32" dia. equatorial mountings. Ball-bearing design 1"- to 4.5"- dia. solid steel shafts, 51# to 680# heads. From $300 to $6,800. Accessories: Circles, Cradles, Wedges, Piers. Send for free catalog.



Shown: 4" shafts & (2) 16" drives, $8,285.00 for 22" f/5 Newtonian.

Bargain Books

- **Save up to 80%** on recent publishers' overstocks, imports, reprints.
- **Save 30% or more** on a wide selection of current books and best sellers!
- **Astronomy**, Photography, Science, Nature, Travel—over 60 subject areas.
- **America's *biggest* bargain book selection.** Our 29th Year.

FREE CATALOG

HAMILTON 5676 Oak
Falls Village, CT 06031-5005

NISUR systems
P3Tri-Pier & Altazimuth mounts
Features: folding eyepiece trays, extendible pier steel bearings, & more P3 Tri-pier $248.
Standard Alta. $115.
Capella Alta. $185.
free brochure

info: 973 566 9624 fax: 973 566 9625
50 Martin st. Bloomfield N.J. 07003

MEGASTAR

"*It's intuitive*, it's easy to use and unbelievably powerful!" That's what we hear from *MegaStar* owners.

Sky Atlas for Windows 3.1, 95 & NT

Ready to buy a computer star atlas? Or maybe the one you're now using gives more pain than pleasure. Then test drive **MegaStar**, and see just how easy it is to get to 15 million stars, 110,000 deep sky objects, 30,000 asteroids, dozens of comets and much, much more. You'll need a 486 PC or better, Windows 3.1, 95 or NT, 5 Mb hard disk space and a CD-ROM. **Download the demo today** at www.willbell.com. **$129.95** postage paid in the U.S.

(800) 825-STAR or (804) 320-7016

Willmann-Bell, Inc. T.M.
Publishers and Booksellers Serving Astronomers Worldwide Since 1973

P.O. Box 35025 • Richmond, VIrginia 23235 • USA • www.willbell.com

TryOrbit for Win95

Hands-on approach. You explore and learn as you make any cislunar orbit.
- Generates an animated two-dimensional simulation of each orbit.
- Detailed listing of orbital angles, positions, lengths & speed graphs.
- 75 equations documented.
- 50 graphic illustrations.

Minimum Requirements:
- VGA monitor. Color SuperVGA monitor recommended.
- Windows® 95, or later.
- NT® 3.51, NT® 4.0 or NT® 5.0

Price $29.98. 30 day money back guarantee. To Canada, add 7% GST Send check or money order to:

Psignologic Services
P. O. Box 34069, Dept. 764
Seattle, WA 98124-1069

Write above for further info & order form.
E-MAIL: timer@axionet.com

ADIRONDACK VIDEO ASTRONOMY
SPECIALIZING IN VIDEO AND CCD IMAGING

New ASTROVID 2000 Video System

☆ **ASTROVID CCD Video Imaging Systems**
☆ ***Starting at $365***
☆ **View the Solar System in Real-Time**
☆ **Perfect for Colleges & Planetariums**
☆ **Record Images to VCR or Camcorder**
☆ **No Computer Required**
☆ **Easy to Use!**

Starlight Xpress

☆ **Europe's Favorite CCD Cameras**
☆ ***Starting at $975***
☆ **MX5 Mono 12 Bit or 16 Bit**
☆ **High Blue Response**
☆ **MX5 One Shot Color**
☆ **Only 50mm x 100mm in Size**
☆ **More Image For Your Money!**

CCD Imaging Accessories
By True Technology Ltd.

☆ **Quickly Find Faces & Center Objects**
☆ **Flip Mirror Finder $239**
☆ **Flip Mirror Filter Finder............ $329**
☆ **Dichroic 5 Filter Tri Color Set...... $179**

CCD Imaging & Atlas Software
☆ Bruce Johnston SuperFix ☆ QMiPS Imaging Software ☆ Software Bisque ☆ CCD Deep-Sky Atlas by Pedro Ré ☆ Deep Sky Imaging Using a CCD Camera

CCD Imaging Books
☆ **The Art & Science of CCD Astronomy**

Rainbow Optics Star Spectroscope
☆ Visual/Photo/CCD-Model $199

ADIRONDACK VIDEO ASTRONOMY
35 Stephanie Ln. ☆ Queensbury, NY 12804 U.S.A.
Toll Free 1-888-799-0107
INFO./FAX: 518-761-0390
http://ourworld.compuserve.com/homepages/AVAastro/

Astronomy's

Marketplace

Laser Collimator

Adjust your mirrors precisely!
Aluminum and stainless accurate to .0002". Premium laser diode 40hr lithium battery. Case and instructions 1 Yr. warranty. 1.25"& 2" model-$125
For 1.25" only-$100. $5 S&H
Howie Glatter, 3850 Sedgwick Ave., Bronx, N.Y 10463
718 796 3203 Write, call or fax for free info.

METEORITES!

Irons. Stones. Stony-irons. Tekites.
Quality display and study specimens.
Space jewelry, books, slides,
Authenticity guaranteed.
Color Catalog $2.

CATCH A FALLING STAR!

Bethany Sciences
P.O. Box 3726-A
New Haven, CT 06525
(203)393-3395

ECLIPSE CRUISE '99 AND TOUR

10 Days from London
Primary Observation site, Irish Sea
"Clearest skies in Western Europe."
SPECIAL Guest Lecturers
* 12 days in Turkey also available
Free newsletter:
"LAST WORD on the STARS"
For Free Information, write to:

TRAVEL WIZARD
7788 University Ave., La Mesa, CA 91941
1-800-708-7677
(619) 464-1946 • FAX: 462-5278
E-mail: lastsword@aol.com

Solar Eclipse Sail

Aegean & Black Seas
July 31- Aug. 14, 1999 or Aug 7-14, 1999

Winter Star Party - Grenadines
S/V Yankee Clipper March 14-20,1999

Tropical Sails Corp.
2516 Sea Palm Dr., El Paso, TX 79936-3013
800-595-1003 915-595-1003
www.tropicalsails.com

TELESCOPE KITS, LENSES, ACHROMATS MIRRORS, MIRROR BLANKS, ALUMINUM COATINGS & ACCESSORIES
BUY DIRECT ★ DO IT YOURSELF

Stock & Custom mirrors and molded mirror blanks, diagonals, parts made from Pyrex, optical glasses, fused silica, quartz and other low expansion ceramic materials. Telescope accessories, do-it-yourself books.

Write, call, fax or e-mail for catalog

NEWPORT GLASS WORKS, LTD.
1629 Monrovia Ave.
Costa Mesa, CA 92627
714-642-9980
FAX: (714) 642-4832
E-mail: ngw@netcom.com
Web: http://www.newportglass.com

Starsplitter Gem

Newtonian Telescopes
Quality Focused on the Customer

4.5" f/8 - $379
4.5" + Motor Drive $479
6" f/5 - $529
Plus Shipping

Standard Features:
German Equatorial Mount
Aluminum Tripod
1.25" Focuser
Polar-Alignment Telescope
6x30mm Finder
15mm Plossl
25mm Plossl

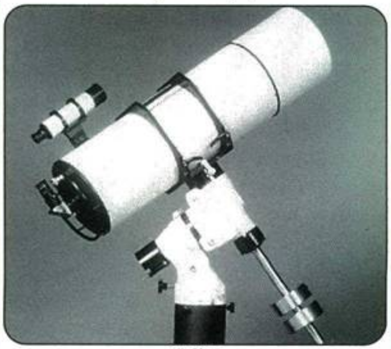
Upgrades:
Drive Motor - $129
Camera Adapter - $24.95

Call or Write 805-492-0489
Phone or Fax

Starsplitter Telescopes
3228 Rikkard Drive
Thousand Oaks, CA 91362

TEC Telescope Engineering

Precision optics up to 60" for amateurs and professionals. Mirror blanks up to 2 meters in diameter. Sitall, Fused Quartz, and other optical materials. Eyepieces and other accessories from Germany and Japan.

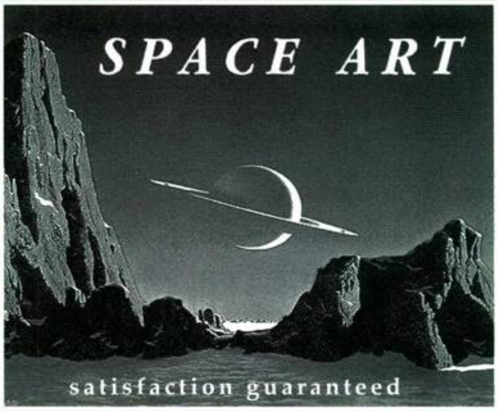


8" f/20

Maksutov Telescopes and Optics up to 16" in diameter and focal ratios from f/4 to f/20. Telescope prices from $3300.

Telescope Engineering Company
15730 W. 6th Ave., Golden, CO 80401
Ph. 303 273 9322
Fax 303 273 0204
e-mail: tlscopng@telcocom.com

SPACE ART



satisfaction guaranteed

PAINTINGS
PRINTS
POSTERS
CARDS

OUR BEAUTIFUL 40-page color catalog $3 USA $5 Int'l

Bonestell McCall Bean Carroll Poor Eggleton Davis Dixon Foster Rawlings Tucciarone Hardy Hartmann Butler Cabrera Hejja Durda Egge *& more*

AUTOGRAPHED ART

Armstrong Glenn Lovell Cernan Bean Conrad Aldrin Shepard Leonov Levy Hale Bopp *& more*

800-727-NOVA
NOVAGRAPHICS
SPACE ART GALLERY

Box 37197-C5
Tucson, AZ
85740

complete selection online ordering
www.novaspace.com

CELESTRON

REFRACTORS		REFLECTORS		DOBSONIANS		SCHMIDTS	
70 mm Alt Azm	199.00	4-1/2" Firstscope	229.00	6" Star Hopper	439.00	G8	999.00
80 Altazimuth	289.00	4-1/2" Deluxe	289.00	8" Star Hopper	529.00	Celestar 8	1,079.00
80 Wide Angle EQ	279.00	4-1/2" Premium	319.00	11" Star Hopper	849.00	Computerized	1,589.00
80 Equatorial	299.00	C114-HD	399.00	14" Star Hopper	1099.00	Deluxe	1,699.00
C102-HD	549.00	150 HD 6"	649.00	17-1/2 Star Hopper	1949.00	Computerized Deluxe	2,199.00

CELESTRON EYEPIECES	
Plossl 6.3, 7.5, 10, 12.5 mm	39.00
Plossl 17, 20, 26 mm	39.00
Plossl 32, 40 mm	49.00
Ultima 5, 7.5, 12.5 mm	79.00
Ultima 18, 24, 30 mm	89.00
Ultima 35, 42 mm	99.00

Visit our showroom in Russellville, Arkansas
Hours: Monday-Friday 10-6 Saturday 9-5
We stock a full line of Celestron & Meade telescopes & accessories.
Call for free discount price list.
Prices subject to change without notice.

AUTHORIZED CELESTRON AND MEADE DEALERS

REX'S ASTRO STUFF

Toll Free Order Line: 1-877-REX-ASTRO
www.astrostuff.com
VISA 63 Observatory Lane • Dover, Arkansas 72837 • TEL: (501) 331-3773 • FAX: (501) 331-3131 MasterCard

krollkraft Sales & Service

A Divison of Wm. H.O. Kroll & Associates, Inc.

Binoculars, Scopes, Telescopes, Tripods,
Mounts, and Accessories.
Domestic, German, Oriental and Russian.

Box One, Excelsior, MN 55331
Phone 612-934-9494 FAX 612-934-1300

NEW AUTHORS

PUBLISH YOUR WORK
ALL SUBJECTS CONSIDERED
Fiction, Biography, Religious, Poetry, Children's.
AUTHORS WORLDWIDE INVITED.
WRITE OR SEND YOUR MANUSCRIPT TO
MINERVA PRESS
2 OLD BROMPTON ROAD, LONDON SW7 3DQ, ENGLAND

CELESTRON®

Now Carrying **MEADE**

- Telescopes, Binoculars, Eyepieces & Accessories.
- Astronomy Books & Supplies.
- Amateur & Shortwave Radio

Radio City

2663 Country Road I
Mounds View, MN, 55112
612-786-4475
radiocity@skypoint.com

BUY • SELL • TRADE

800-426-2891
www.radioinc.com

TWILIGHT TOURS

1999 Total Solar Eclipse Expedition August 6-13th Turkey

- Cost: $2695.00 per person/dbl. occ.
- Includes: r/t coach transatlantic airfare, domestic air in Turkey, first class hotels, ground transfers, porterage, most meals, sightseeing tours & enrichment lectures.
- Deposit: $500.00 per person, refundable until 1/31/99.

Twilight Tours Inc.
22307 Algunas Road
Woodland Hills, CA 91364
Phone: (818) 841-8245
Fax: (818) 566-9677
E-mail: eclipse@cerfnet.com

ECLIPSE SHADES™

Safe Solar Viewers

Custom Imprinting Available!

ECLIPSE SHADES
SAFE FOR DIRECT SOLAR VIEWING

Eclipse Shades™ provide the ultimate in protection from harmful Solar Radiation. Lenses made of Optical Grade, Neutral Density 5 Mylar, filter out 100% of Ultra-Violet, 100% of Infra-Red, and 99.999% of Visible Light.

Quality Paper Eyewear & Specialty Optics

Rainbow Symphony, Inc.
6860 Canby Ave. #120, Reseda, CA 91335
1-800-821-5122 FAX (818) 708-8470
E-Mail: eclipse@rainbowsymphony.com
www.rainbowsymphony.com/soleclipse.html

Buy a Star ★ Name a Star

★ On the exclusive
MSAS Star Atlas
to be placed in our future
observatory & science center.

Receive a certificate of record and more.

Free brochure.

Starting at only $30.00!

VISA/MC accepted

Mtn. Skies Astronomical Society
Box 1169 - Lake Arhd, CA 92352

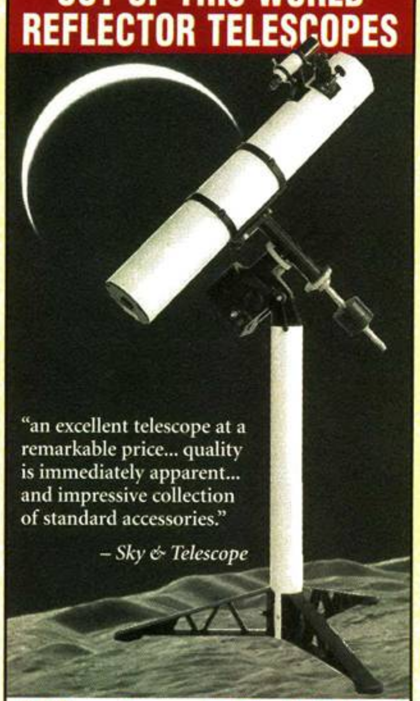
(909) 336-1699
www.mountain-skies.org

SKYWATCHER'S INN

THE ARIZONA ASTRONOMY
AND NATURE RETREAT

BED AND BREAKFAST at the **VEGA-BRAY OBSERVATORY** (see *Astronomy* magazine October 1994, and *Sky & Telescope*, December 1995).
New, modern, and comfortable lodging.
Many **TELESCOPES** from 6 to 20 inches, computer slewing and **CCD** imaging.
Science museum and planetarium.
DARK SKIES AND SPARKLING DAYS.
47 miles east of Tuscon, 28 miles from Tombstone.
Close to many astronomical observatories, Native American, historical and natural attractions.
Our astronomy observing sessions are at least four hours long, for a single person or a group.
We do not mix groups so you have full control of the astronomer, the telescopes, and your entire evening program.
By appointment only: Tel/fax: (520) 745-2390
c/o 420 South Essex Lane, Tuscon, Arizona 85711
http://www.communiverse.com/skywatcher
E-mail address: vegasky@azstarnet.com

OUT OF THIS WORLD REFLECTOR TELESCOPES



"an excellent telescope at a remarkable price... quality is immediately apparent... and impressive collection of standard accessories."

– *Sky & Telescope*

At Very Down to Earth Prices!

See what you've been missing, from the craters of the moon to the rings of Saturn, with these spectacular 110mm (4.3") and 150mm (6") Newtonians for much less than you'd expect to pay! Diffraction-limited optics, loads of *free* accessories and rugged, all metal construction (even the tube) – old-world quality! Complete with precision-machined German equatorial mount with clock drive on solid metal pedestal with built-in anti-vibration pads. 110mm complete with interchangeable 1.25" eyepieces (15mm Kellner & 25mm plossl), 6x30 finderscope and Barlow lens; 150mm also includes 42mm eyepiece and 8x50 finderscope. Set of six glass filters and tongue & groove wooden storage cases included with each. A real value! One-year warranty; 30-day money-back satisfaction guarantee. Quantities limited.

Just **$499*** *for 110mm; only* **$749** *for 150mm!*

Equatorial mounts, mirrors, eyepieces and accessories now sold separately! Call for details.

SOVIETSKI COLLECTION™
Treasures from a Bygone Era®

CALL NOW! 800-442-0002

3450 Kurtz St., #C, San Diego, CA 92110 • Fax (619) 294-2500
http://www.sovietski.com • e-mail: sales@sovietski.com
*Plus S/H • We Ship Worldwide.

GET A BETTER START FOR LESS

BUILD YOUR OWN SCOPE WITH STARGAZER STEVE

You'll see more with this exceptional long-focus scope that you've made yourself in a day! Follow the video to success!

IN EVERY KIT:
Deluxe Plasticised
"Night Sky" Starfinder
by David Chandler
correct for your
latitude.

Stargazer Steve

"... an ideal project for a parent and child to work on together ...I felt a tremendous sense of discovery."
- Scott Barrie in Nov/Dec'97 Sky News

"...exquisite craftsmanship... a great school science project... ...veterans will have fun with it too."
- Glenn Chaple in Dec/97 Astronomy

THE 4 1/4-INCH DELUXE REFLECTOR KIT
$229.00 from Stargazer Steve.

1752 Rutherglen Cr. Sudbury, ON Canada P3A 2K3,
Tel: (705) 566-1314 Website http://ww2.isys.ca/stargazer

Astronomy's
Marketplace

TRACKING for DOBS
* High power observing and group viewing
*Astro-imaging with NO field rotation
call or write for free brochure
EQUATORIAL PLATFORMS 530-265-3183
11065 Peaceful Valley Rd. Nevada City, CA 95959
tomosy@nccn.net www.Astronomy-Mall.com

STARMASTER PORTABLE TELESCOPES
Hi Performance Dobs. Truss Mounted Scopes ranging in sizes from 12.5" F-6 up to 22" F-4.5.
Route 1, Box 780 · Arcadia, KS 66711
or Call: (316) 638-4743
4:00-8:00 pm C.S.T. 7 days a Week.
http://www.icstars.com/starmaster

SINGLES IN SCIENCE
and others interested in science/nature are meeting through *Science Connection*
800-667-5179
www.sciconnect.com/

***BINOCULAR MOUNTS* by Virgo**
from $29.95 to $399.95 5 NEW Designs-CALL US!
Virgo Astronomics
HIGH QUALITY, PROFESSIONAL GRADE
BINOCULAR HOLDERS & MOUNTING SYSTEMS
608 Falconbridge Dr. Ste.46, Joppa MD 21085 USA
ph: 410 679 7055 fax: 410 679 2376
e-mail: virgoastronomics@erols.com
FREE catalogue - also on www.Astronomy-Mall.com
See us for dew-caps, tripods, red-dot finders, T-brackets, books, bags and much more!!

TUTHILL,
YOUR ASTRONOMICAL FRIEND SAYS:
Every Meade ETX Scope needs our:
NO DU Cap, Battery Warning Light,
Field Tripod, Solar Skreen,
Piggy Back Mount,
ETX User Video, and Finder.

For info on our custom-made Tuthill ETX accessories send SASE 9"X12" w/4 stamps to:

Roger W. Tuthill, Box 1086e,
Mountainside, NJ 07092

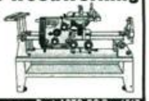
Brandons
Used exclusively by QUESTAR, these eyepieces are also the choice of experienced telescope observers. Best contrast possible. Thousands made annually at our Candor factory. World-famous DAKIN Barlows, filters, 1/20th wave diagonals, Amici's, adapters. Send $1.00 for flyers.
VERNONscope & Co.
5 Ithaca Road • Candor, NY 13743
607-659-7000 Fax 659-4000

METEORITES
Own a piece of another world!
Free Color Meteorite Catalogue
New England Meteoritical Services
Box 440-A, Mendon MA 01756 USA
Tel 508-478-4020 Fax 508-478-5104
www.meteorlab.com

Tell advertisers you saw their ad in
Astronomy.

DURABLE HIGH-QUALITY COATINGS
With our ENDUROBRIGHT™ COATINGS you will get the most durable and pinhole-free front-surface mirror coatings on the market today! GUARANTEED
- QSP's PROTECTED ALUMINUM coating >89%
- QSP's SEMI-ENHANCED coating >92%
- QSP's ENHANCED coating >96%
- turnaround for PAL mirrors less than 12.5" 7 working days
- turnaround for EAL mirrors less than 12.5" 14-21 working days
- SLAR and High-Efficiency AR coatings upon request
- up to 44-inch diameter
- ENDUROBRIGHT™ dielectric coatings upon request

QSP
QSP Optical Technology, Inc.
1712-F Newport Circle
Santa Ana, CA 92705
Phone: 714-557-2299 • Fax: 714-557-2170
http://www.QSPtech.com



ULTIMATE HOME SHOP
Complete tools for metal & woodworking
Starting at **$995** — Smithy —
Easy to use
Versatile
Affordable
FREE CATALOG
Call 1-800-345-6342 or write: **Smithy** Dept. ASTC, PO Box 1517 Ann Arbor, MI 48106-1517

MILLENNIUM
1999 Total Solar Eclipse
AUSTRIA or TURKEY
If you missed the first total solar eclipse of this millennium on Sept. 19, 1001 (*Aethelred the Unready* was King of England), don't miss the last one – Aug. 11, 1999
INNOVATIONS IN TRAVEL OF ANNAPOLIS
800-733-3361 ★ innovations2@juno.com

Sky Valley Scopes
Custom Built Newtonian Telescopes
Oak Veneer and Fiberglass Tubes for your Homebuilt Scope or to replace existing cardboard tubes.
Call or write for free brochure and prices
9215 Mero Rd. Snohomish, WA 98290
(360) 794-7757 • info@skyvalleyscopes.com
Come visit our new website at:
http://www.skyvalleyscopes.com

International Dark-Sky Association
Promoting efficient lighting to reduce glare, to conserve energy, and to preserve the beauty of our night skies
To learn about *light pollution, energy waste, light trespass,* and related issues, or to join, ($30 basic membership), call or write to the non-profit
International Dark-Sky Association,
3225 N. First Avenue
Tucson, AZ 85719-2103
(520) 293-3198
(520) 293-3192 (fax)
http://www.darksky.org

MARS VR

PATHFINDER MISSION CD-ROM WITH PHOTOS,
SCIENCE RESULTS, ROVER MOVIES, AND
VR TOUR OF THE LANDING SITE.
$39.95 + S&H CALL 1-800-685-5397
WWW.VRCAMERA.COM
FOR MAC OS AND WINDOWS 95

STARSPLITTER TELESCOPES

INNOVATIVE DESIGNS IN ALT-AZ NEWTONIANS
SUPERIOR QUALITY & PERFORMANCE

"EXPERIENCE A NEW UNIVERSE"

MODELS TO FIT YOUR BUDGET

COMPLETE SYSTEMS OR INSTALL YOUR OPTICS

FOR INFORMATION OR COMPONENTS CATALOG CALL OR WRITE:

STARSPLITTER TELESCOPES
3228 RIKKARD DRIVE
THOUSAND OAKS, CA 91362
805-492-0489
PHONE/FAX

STARSPLITTER COMPACT & COMPACT II
8", 10", 12.5", 14.5",15"

STARSPLITTER II
15" - 30"

STARSPLITTER@EZ2.NET

HTTP//WWW.STARSPLITTER.COM

ECLIPSE VIDEO

Experience the 1998 solar eclipse from the "Fascination" near Aruba.
Quality 40 Minute edited video
$34.95 + 4.95 S&H
800-243-3077 credit card orders
Check/money orders to:
ECLIPSE VIDEO
3516A Mill St., Bemidji, MN 56601

Eclipse Cruises '99

Vistafjord - Black Sea
14 days Aug. 4 from $3465

Olympic Countess - Black Sea
7 days Aug. 6 $1352

Royal Princess - British Isles
PRINCESS CRUISES 12 days Aug. 10 British Registry

Norwegian Sky - British Isles
NORWEGIAN 10 days Aug. 9

Splendor of the Seas - British Isles
12 days Aug. 9

Call Chris at Montrose Travel for more information
(800) 666-8767 or (818) 553-3242
CST# 1018299-10

8" f/6 or 12.5" f/5

Take It For A Spin!

Mag1 Instruments Portaball
Quick Set-up • Rotatable Tube
Exceptional Optics

SEE It Spin Online!

mag1instruments.com
414-785-0926

KITES

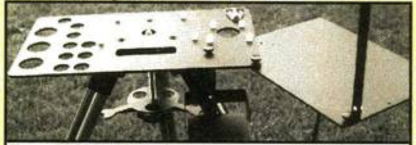
FREE COLOR CATALOG
Choose from over 200 exiting kites.
• Many unusual & innovative designs.
Call or write for your catalog today!
Into The Wind • **(800) 541-0314**
1408-A Pearl St., Boulder, CO 80302

Business Opportunity!

- Earn up to $500 per day! Start your own astronomy business with a STARLAB Portable Planetarium.
- Initial investment as low as $9950.
- Visit our web site: **www.starlab.com** or call for info.

Learning Technologies, Inc.
40 Cameron Ave., Somerville, MA 02144
Ph: 800-537-8703 • Fax: 617-628-8606

ScopeSaver BB200 Observing Table **NEW ACCESSORY**



The **BB200 Observing Table** is an integral part of **ScopeSaver's** observing workstation that fits all **Meade** S/C telescopes using a standard tripod, all **Meade** APO refractors and selected **Celestron** S/C telescopes. The 12"x20"x1⁄4" table is milled from aircraft-grade aluminum plate and black anodized to inhibit corrosion. It has a precision cross-check level to easily align the tripod prior to mounting the scope. Nylon registration guides simplify mounting in the Alt/Az configuration: *simply lean the scope against the guides, let it down, and it's perfectly aligned with the retaining bolt.* The **BB200** has registers for the keypad to provide a secure flat location and enable one-hand usage. Also included are nine 1¼" and three 2" holes for eyepieces giving you easy access while observing. It accommodates equatorial wedges, and with $10 keypad kit, super wedges. Only $99+s/h. **Workstation accessories: 4-hole 2" eyepiece holder,** $45**;** Reference/Laptop Table, $54; Table Brace, $18; Beverage Holder, $23; ScopeSaver Jr. Mounting Plate, $50. Amex, M/C, Visa. **800/330-8339**. Call today, or write to **Beigle/Bryant Engineering,** 14826 Willow Glen Court, Canyon Country, CA 91351. Ph: 805-298-0098, Fax: 805-298-0009.

UNIVERSITY OPTICS, INC.
P.O. BOX 1205
ANN ARBOR, MICHIGAN 48106-1205

For over 37 years your source for everything astronomical including —
- Cookbook CCD Camera kits
- Eyepieces
- Telescope making parts

New Online Catalog
www.universityoptics.com

Call for **FREE CATALOG**
734-665-3575

The Original And The Best! NOW ON THE WEB!

OBSESSED WITH THE BEST?

We are. Nothing else comes close to an Obsession.

Apertures from 15-30 inches.

Get Obsessed now. Brochure $2, with a 2hr. video, $5.

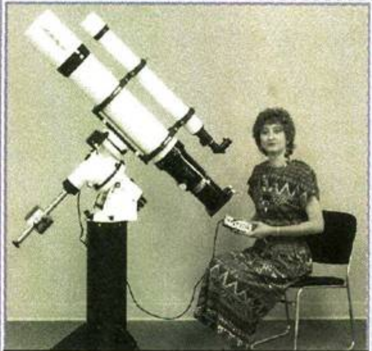
PO Box 804a
Lake Mills, WI 53551
(920) 648-2328 • Fax also

OBSESSION TELESCOPES™
www.globaldialog.com/~obsessiontscp/OBHP.html

ASTRO-PHYSICS

High-quality instruments for discriminating observers and astrophotographers

Refractors- 105,130,155 mm dia.
German Equatorial Mountings
Visual and Photographic Accessories



155 StarFire EDF with 4" Focuser,
900 German Equatorial
80mm Guidescope, accessories

11250 Forest Hills Rd.
Rockford, IL 61115 USA
Ph: 815-282-1513, Fax: 815-282-9847

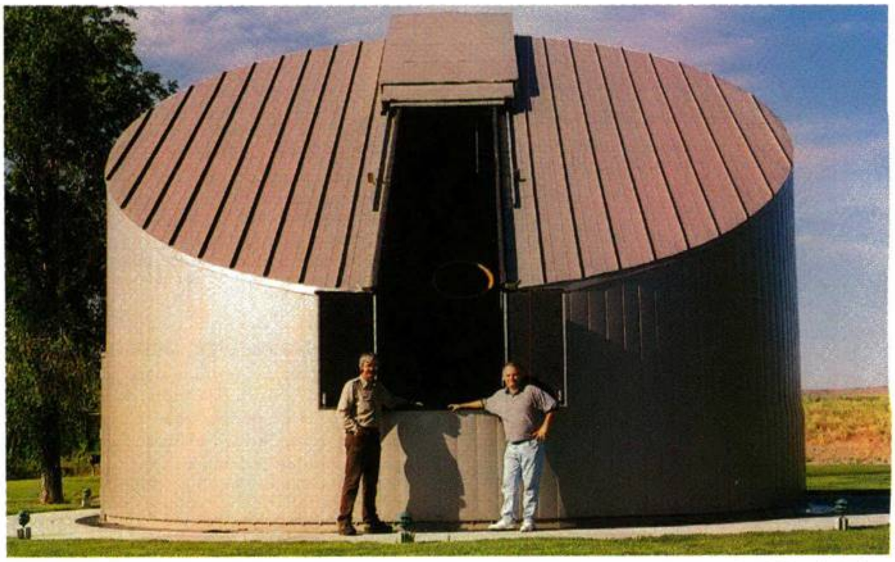
SOLAR ECLIPSE TOURS AUGUST 1999

Join us to witness the FINAL Total Solar Eclipse of the Millennium

Baltic Republics Cruise
Danube River Journey
Turkish Land Odyssey
Black Sea Cruise

Journeys for Inquisitive Minds
TravelQuest INTERNATIONAL

Call for **FREE Brochure**
800 830-1998
570 Skyview Dr., Prescott, Arizona 86303



Kevin Meyer (left) and Richard Beaver pose with the Boise Astronomical Society's new observatory.

Richard Beaver

The Boise Astronomical Society (BAS) has joined forces with the Idaho Department of Parks and Recreation to establish a new public observatory located in Bruneau Dunes State Park, near Bruneau, Idaho. This observatory houses a 25-inch Obsession telescope, equipped with an 8-inch CCD camera. The 25-ton building has the ability to rotate 360° in four minutes on a 30-foot diameter track.

The facility, valued at approximately $250,000, was paid for by BAS and Idaho Department of Parks and Recreation fundraising, along with generous corporate donations, using no tax dollars. Most of the contributors had never had the opportunity to view the heavens through a telescope — until now.

The observatory will be used by schools and civic groups, as well as the general public. School children will have the opportunity to camp out overnight and view through the telescope or watch real-time images. Daytime tour groups will view stored images on a screen in the observatory. The park has added astronomy to its existing biology and geology tours.

This ten-year project culminated with an inaugural ceremony May 9. The observatory is now open for public viewing Friday and Saturday evenings, which typically draw 70 to 100 people per night. Photos of the observatory can be viewed at the BAS website, http://www.isidaho.com/bas/.

OCTOBER 2–3

Astro-Assembly

▶ Seagrave Memorial Observatory, North Scituate, Rhode Island. Contact Bob Napier, (401) 934-0980; website, http://chandra.cis.brown.edu/astro.

OCTOBER 2–4

Midwest Space Development Conference

▶ Holiday Inn, Akron, Ohio. Contact MSDC, 6167 Oakwood Circle, North Ridgeville, OH 44039.

OCTOBER 3

Astronomical Swapmeet

▶ Moorpark College Observatory, Moorpark, California. Contact Dave Holland, (805) 526-4032; e-mail, Ravndave@ix.netcom.com.

OCTOBER 3

Annual Convention of the South East Region of the Astronomical League

▶ St. Augustine High School Observatory, St. Augustine, Florida. For information send a SASE with 55¢ postage to Ton Ponjee, Sercon '98, P. O. Box 354030, Palm Coast, FL 32135.

OCTOBER 10–12

National Astronomy Meeting

▶ Planetario Humboldt, Parque del Este, Caracas, Venezuela. Telephone, 058-02-2349188; e-mail, planehum@truevision.com or 104721.1224@compuserve.com.

OCTOBER 11–16

Annual Meeting of the Division for Planetary Sciences

▶ Monona Terrace Convention Center, Madison, Wisconsin. Contact DPS '98, c/o SSEC, UW-Madison, 1225 West Dayton Street, Madison, WI 53706; e-mail, dps98@ssec.wisc.edu; website, http://www.ssec.wisc.edu/.

OCTOBER 13–17

Twin Lakes Star Party

▶ Land Between the Lakes National Recreation Area, Murray, Kentucky. Contact Ross Workman, 508 Park Avenue, Dawson Springs, KY 42408; (502) 797-8959; e-mail, planetman@kih.net.

OCTOBER 14–18

Deep South Regional Stargaze

▶ Percy Quin State Park, near McComb, Mississippi. Contact Barry Simon, 820 Emerald Street, New Orleans, LA 70124; (504) 283-7592; e-mail, bsimon615@aol.com.

OCTOBER 15–18

Enchanted Skies Star Party

▶ Socorro, New Mexico. Contact the Enchanted Skies Star Party, P.O. Box 743-I, Socorro, NM 87801; (505) 835-0424; e-mail, jmares@admin.nmt.edu; website, http://www.nmt.edu/~astro/essp.html.

OCTOBER 16–17

Astronomy Festival

▶ Kopernik Space Education Center, Vestal, New York. Contact Kopernik Astronomical Society, Kopernik Space Education Center, 698 Underwood Road, Vestal, NY 13850; (607) 748-3685; website, http://www. kopernik.org.

OCTOBER 16–18

Astronomy Camp for Beginning Adults

▶ Mt. Lemmon and Bigelow Observatories, University of Arizona, Tucson, Arizona. Contact Don McCarthy, 933 N. Cherry Ave., Tucson, AZ 85721-0065; (520) 621-4079, e-mail, dmccarthy@as.arizona.edu; website, http://ethel.as.arizona.edu/astro_camp.

OCTOBER 16–18
Custer Astronomy Jamboree

▶ Custer Institute Observatory, Southold, New York. Contact George Vrattos, Custer Institute, Inc., P. O. Box 1024, Southold, NY 11971; (516) 765-2626; website, http://www.custerobservatory.org.

OCTOBER 16–18
Eastern Iowa Star Party

▶ Monsignor Menke Observatory, Wapsi River Environmental Education Center, near Dixon, Iowa. Contact Bill Brown, (309) 786-9622 (eve.); e-mail, bibrown@compuserve.com.

OCTOBER 16–18
Stella-Della-Valley Amateur Astronomers' Convention

▶ Camp Onas, Ottsville, Pennsylvania. Sponsored by the Bucks-Mont Astronomical Association. Contact Ed Radomski, (215) 822-8312; e-mail, Ejrado@aol.com.

OCTOBER 17
Planet Watch

▶ Riker Hill Art Park, Livingston, New Jersey. Contact (973) 596-6529; website, http://rutgers-newark.rutgers.edu/dreyfuss.

OCTOBER 18–25
Okie-Tex Star Party

▶ Prude Ranch, Fort Davis, Texas. Contact the Oklahoma City Astronomy Club, P. O. Box 128, Mustang, OK 73064; Steve Adkins, (405) 722-1678 (eve.); e-mail, seadkins@icon.net; website, http://www.icon.net/~seadkins/okie-tex.html.

OCTOBER 21–24
Great Lakes Planetarium Association (GLPA) Conference

▶ Seasons Conference Center, Nashville, Indiana. Contact Dan Goins, Martinsville High School Planetarium, 1369 E. Gray Street, Martinsville, IN 46151; (765) 342-5571; e-mail, glpa@scican.net.

OCTOBER 22–24
Mt. Magazine Star Party

▶ Mt. Magazine, Arkansas. Contact Jim Bielaga, 1591 Pollard Cemetery Road, Dover, AR 72837; (501) 331-3773 (day), (501) 331-3620 (eve.); e-mail, cygnusx1@mail.cswnet.com.

OCTOBER 22–27
Mid-Atlantic Star Party

▶ Boy Scout Camporee Camp Reeves, South of Robbins, North Carolina. For information send an SASE to MASP, 244 Deerfield Road, Apex, NC 27502; (919) 362-5194; e-mail, john@bsa.net.

OCTOBER 23–24
Blackwater Falls Astronomy Weekend

▶ Blackwater Falls State Park, Davis, West Virginia. Contact Ron Cockeram, 5216 Bailey Road, Cross Lanes, WV 25313; (800) 225-5982; website, http://www.earth1.net/kvas/.

OCTOBER 23–25
Annual Meeting of the Antique Telescope Society

▶ Harvard University, Cambridge, Massachusetts. Contact Walter Breyer, 1275 Poplar Grove Lane, Cumming, GA 30041; e-mail, whbreyer@mindspring.com.

OCTOBER 24
Colorado Astronomy Day

▶ University of Denver campus, Denver, Colorado. Sponsored by the Denver Astronomical Society, Gates Planetarium, and Chamberlin Observatory. Contact Steve Solon, 9774 West Elmhurst Place, Littleton, CO 80128; (303) 932-7613; e-mail, 103662.3103@compuserve.com.

OCTOBER 24
Free Public Star Party

▶ Ralph A. Worley Observatory, south of Shreveport, Louisiana. Contact Cran Lucas, (318) 797-1524; website, http://www.lsus.edu/ nonprofit/sbas/.

OCTOBER 29–NOVEMBER 1
Annual Meeting of the American Association of Variable Star Observers (AAVSO)

▶ Cambridge, Massachusetts. Contact AAVSO – Meetings, 25 Birch Street, Cambridge, MA 02138; e-mail, meetings@aavso.org; website, http://www. aavso.org.

CONTACT

Please submit club announcements four months in advance to Looking Ahead, *Astronomy*, P.O. Box 1612, Waukesha, WI 53187, or to tconley@astronomy.com. Look for additional events at http://www.astronomy.com.

NOW! MORE CHOICES
•Everything Astronomical
•Terrific Bargain Prices
•Expert Personal Service

from Spectra Astro • Systems

SPECTRA PROUDLY FEATURES THE FINE ASTRONOMY PRODUCTS OF THESE COMPANIES AND MANY MORE!

CELESTRON CELESTRON INTERNATIONAL
SBIG ASTRONOMICAL INSTRUMENTS
TAKAHASHI
TeleVue
LOSMANDY EQUATORIAL MOUNTS
TelRad
Optics
1,000 OAKS
DayStar Filters
PELICAN Protective Equipment Cases
JMI
FUJINON Binoculars
LUMICON
Parallax Instuments
TAMRON
UNIVERSITY OPTICS, INC.

CALL, WRITE OR FAX FOR FREE CATALOG
MON 12-5, TUES-FRI 10-5 CALIF. TIME
(800) 735-1352
E-Mail: info@spectraastro.com
http://www.rahul.net/resource/spectra
FAX 24HRS (818) 996-7698

ASTRO PIER
Telescope Mounting Piers

Are you tired of leveling and lining up on North?

The Astro Pier virtually eliminates vibration from accidental jarring and totally eliminates the need to level and line up on North, allowing for undelayed observing and excellent astro photography. Constructed from 1/4" and 3/8" welded steel and three 3/4" leveling bolts for excellent performance.
Mounting piers for Schmidt-Cassegrain, Refractors and Newtonian.
Colors: Midnight Blue, Black or White

LE SUEUR MANUFACTURING CO., INC.
3220 Lorna Road
Birmingham, Alabama 35216
Phone (205) 822-0720, Fax (205) 822-0749
www.astropier.com
Starting at $245 plus S/H

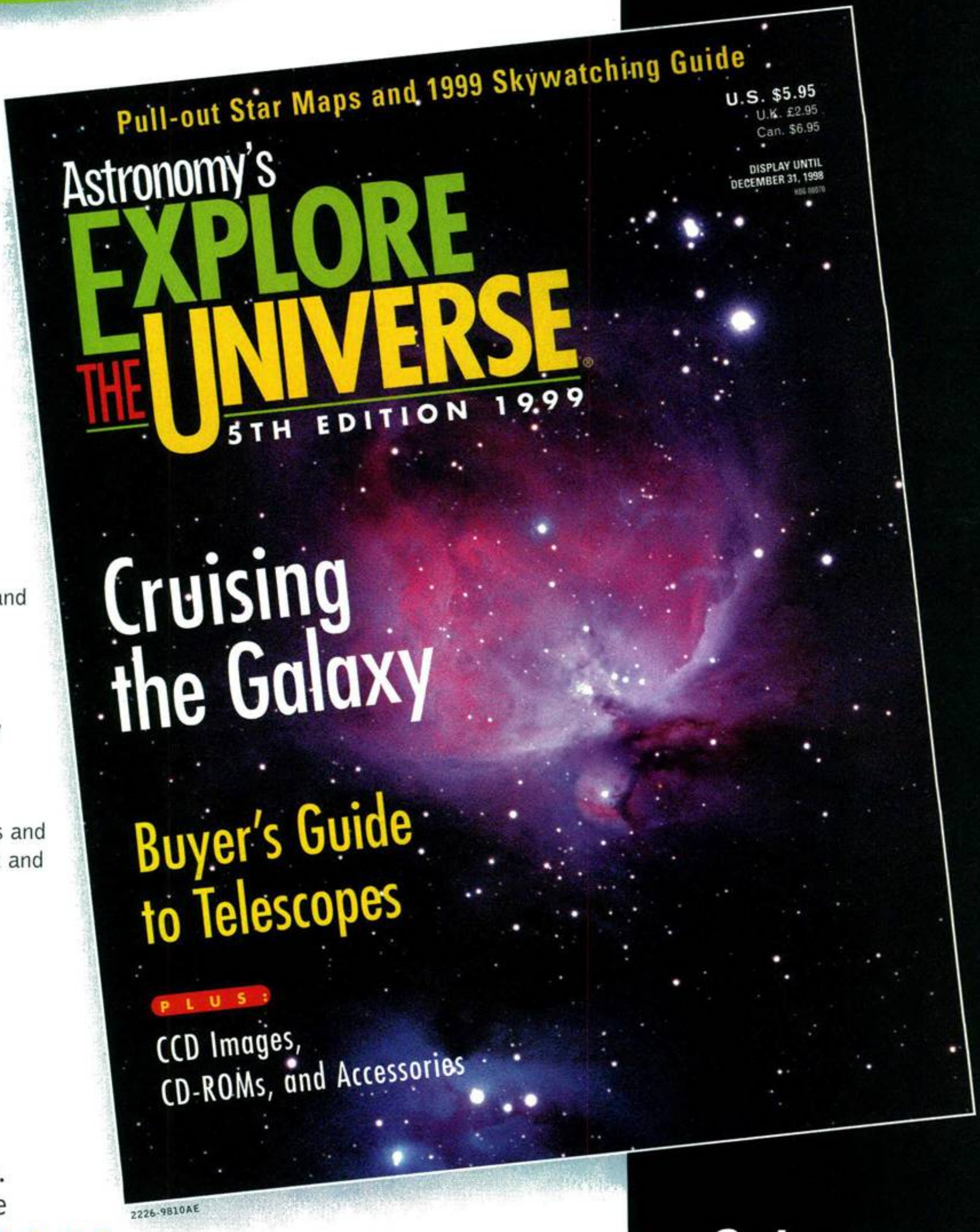
VISA/MASTERCARD NO C.O.D.s

ON
SALE NOW

Cruise a universe you've never seen before!

Explore the Universe 1999 plunges you deep into space with the latest astronomical news on planets, stars, and galaxies. This special annual from *Astronomy* also offers you observing equipment reviews and free monthly sky charts to heighten your sky watching enjoyment.

- Hear directly from amateur and professional astronomers on how this exciting science changed their lives
- Learn how and where to view the most recent findings in deep space
- Choose the correct telescopes and accessories to fit your budget and stargazing abilities
- See never-before-published celestial images
- Get a helpful glossary of astronomical terms


Pull-out Star Maps and 1999 Skywatching Guide
U.S. $5.95
U.K. £2.95
Can. $6.95
DISPLAY UNTIL DECEMBER 31, 1998
Astronomy's
EXPLORE
THE UNIVERSE
5TH EDITION 1999
Cruising the Galaxy
Buyer's Guide to Telescopes
PLUS:
CCD Images, CD-ROMs, and Accessories
2226-9810AE

Pick it up at your local newsstand or bookstore. Or to order, call toll-free

1-800-533-6644

Call Monday–Friday 8:30am to 5:00pm Central Time. Please have your credit card ready. Fax 414-796-1615. Outside the U.S. and Canada, call 414-796-8776, ext. 661.

Or send your order to
Kalmbach Publishing Co., Dept. A8AAY, 21027 Crossroads Circle,
PO Box 1612, Waukesha, WI 53187-1612.
Please include a check or money order for $5.95 ($6.95 Canadian and foreign, includes GST).

A8AAY

Get your copy today!

Anyone can sell you a telescope.

Authorized Meade Dealer

We'll sell you the *right* telescope.

Hardly a day goes by that we don't get a note or E-mail message like the one reprinted below, or a call that goes something like this: "Your ads are right. So and so on the East Coast advertises low prices – but they don't have what I want in stock, they couldn't answer *any* of my questions, and they wanted my credit card number before they'd even *talk* to me. They said if I wanted to ask questions, I should call the manufacturer . . . and then they hung up on me!" One of our customers added, "If I wanted that kind of abuse, I would have called my ex-wife."

If you want the right telescope, you need more than a camera store clerk with a price list, a surly attitude, and a wild guess.

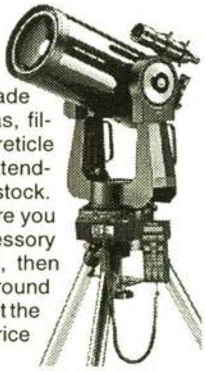
What you *really* need are people who will take the time to listen to what *you* need, people with years of experience using and selling telescopes, people who can help you get the most telescope for your dollar. That's exactly the kind of people you'll find at ***astronomics***.

Unlike camera stores and shopping mall gift shops, telescopes are our specialty at ***astronomics***, not a sideline. We're a family-owned full-line telescope dealer – not just a few scopes stuck off in the corner of some no-help department store, toy store, or gift shop as an afterthought. We don't work on commission, so we won't try to sell you more than you need just to pad our paychecks.

We've been helping people choose the right telescope since 1979. We have the experience to help *you* pick the scope that fits your needs . . . *and your budget* . . . from the more than 100 different Meade, Celestron, TeleVue, Takahashi, and Questar models we carry – all discount priced from $99 to $27,995.

astronomics. No hard sell. No guesswork. Just honest advice, the *right* telescope . . . and a good price. Call us at (405) 364-0858 and find out for yourself.

We have the latest Meade scopes and accessories in stock . . .



It doesn't matter whether the right telescope for you is a fully computerized 8" or 10" **LX200 Schmidt-Cassegrain**, the 7" **LX200 Maksutov-Cassegrain** to the right; any of the 8" or 10" **LX50**s; the hot new 3.5" **ETX Maksutov** shown above; or the 8" German mount **203SC/500** Schmidt-Cassegrain shown to the left. If Meade is shipping it for a dealer to keep in stock, the chances are good that we *have* it in stock.

Why do we have it when other dealers don't? The day before this copy was written, we got in 305 cartons of scopes and accessories from Meade in one shipment. We don't know of many other dealers – if any – who order Meade products in those quantities. But we do. Meade scopes, binoculars, eyepieces, CCD cameras, filters, Barlows, off-axis guiders, illuminated reticle eyepieces, counterweights, T-adapters, tele-extenders, Magellan computers – we have them all in stock.

Meade prices are about the same anywhere you call. So why order a Meade telescope or accessory from a dealer who charges your credit card, then makes you wait and wait until he finally gets around to ordering what you want? Not when you can get the Meade you want . . . right now . . . at the right price . . . right here at ***astronomics***.

Free freight on this Dob!

Celestron 8" f/6 Star Hopper Dobsonian

$499
freight paid!

While quantities last (and we have fewer than 100 in stock), we're picking up the freight on this full-size Celestron Dobsonian.

That means the 8" Star Hopper Dobsonian is yours for only $499, freight paid! (Some dealers charge a whopping $60 freight!) You can have this big scope in your hands in less than a week for a dollar less than a $500 bill.

Economy scopes for the star-gazer on a budget!

Celestron Tabletop 76 reflector
$99

Celestron FS114S reflector
$219

While we're known for carrying ultra-premium optics, not all of our scopes are budget-busters. We have seven priced between $99 and $249, and fourteen between $249 and $499. All are surprisingly good optically. All are shown in our catalog. Call (405) 364-0858 for your free copy.

Our free catalog helps you pick the right Meade, Celestron, Questar, Takahashi, or TeleVue.

For detailed information on individual products, visit our Web site. Or you can call us at (405) 364-0858 or E-Mail us for your *free* copy of our catalog 98AST. It covers all of the telescopes and accessories we stock – from Apogee, Celestron, DayStar, JMI, Lumicon, Meade, Optec, Pentax, Questar, Rigel Systems, SBIG, Software Bisque, Takahashi, TeleVue, and more. We'll include our 8-page guide on how to pick the right scope and your discount prices on the 1000+ products we carry. (Sorry, U. S. sales only.) The catalog is yours for only the cost of a one minute telephone call. The information we send will make it the most useful minute you'll ever invest in astronomy.

446 telescopes in stock!

At the time this ad was written (11:30 AM on 7/7/98), we had 446 scopes *in stock* and another 355 on order. That didn't count the scopes in the 134-carton motor freight and 25-carton UPS shipments being unloaded as these words were being written. Unlike some dealers who only *claim* they have scopes in stock, we really *do* have a big inventory.

```
I purchased the 8" DOB (Celestron) back in Janurary from you.  I just wanted
to let you know that your service was top notch and I appreciate all the
help.  We love our new scope (although the skies have been pretty cloudy)
but the nights that have been clear have been spectacular.  You have earned
a lifetime customer from us and we will recomend you to all our friends.
Keep up the great work!!!
```

Customer E-Mail Quote of the Month #79

astronomics

Our 20th year of friendly service, good advice, and money-saving prices.

2401 Tee Circle, Suites 105/106, Norman, OK 73069
Toll-Free Order Line: **(800) 422-7876** Catalogs/Questions/Advice: **(405) 364-0858**
24-Hour FAX: (405) 447-3337 E-mail: questions@astronomics.com
Our award-winning Internet address: www.astronomics.com America On-Line: okastro
10 to 8 CST, Mon. thru Fri., Saturday 12 to 5. We accept Mastercard, Visa, Discover, and American Express. U. S. sales *only*.
No credit card surcharge. $5.95 minimum freight. Restocking fees apply to returns for credit and to merchandise returned in used or damaged condition.

ADORAMA INC.

42 WEST 18th STREET • NEW YORK, NY 10011

PHONE ORDERS ACCEPTED DAY OR NIGHT
- Mon–Thurs. 9 till 9:30 PM
- Fri. 9-1:45
- Sunday 9:30–6 EST

STORE HOURS:
- Mon.–Thurs. 9–7pm
- Fri to 1:45
- SUN 9:30–5:45

ORDER TOLL FREE • US & CANADA
800-7-ADORAMA
8 0 0 - 7 2 3 - 6 7 2 6

ORDERS & INFO **212-647-9800** | FAX **212-675-8715**

CUSTOMER RELATIONS • 800-815-0702
• Mon–Thur. 9–4:30, Sun. 11-2 EST
E-mail: goadorama@aol.com

COMPLETE with MANUFACTURER'S ACCESSORIES

USED TELESCOPES

READY TO UPGRADE YOUR TELESCOPE?
CALL US FOR AN EVALUATION
LOOKING TO BUY A USED TELESCOPE?

We Deal in Previously Owned Telescopes, Spotting Scopes & Acces.

CELESTRON®
SCHMIDT CASSEGRAIN

ULTIMA 2000	**Call**
Ultima 9¼ PEC	**Call**
Ultima 11 PEC	**Call**
CG-9¼	**Call**
CG-11	**Call**
New CM-1100	**Call**
New CM-1400	**Call**
Celestar 8	**Call**
Celestar 8 computerized	**Call**
Hand Control f/Celestar	**54.95**
Celestar 8 Deluxe	**Call**
8" S.C. Tube only	**749.95**
New G-8 German Eq. 8"	**Call**

Celestron
5" compact scope
C5+ 1250 F/10
Schmidt Cassegrain

C5+Telescope w/DC Drive	**Call**
C5 Spotting Scope	**Call**
C5 Tripod	**179.95**
Glass Solar Filter for C5	**64.95**
Radial Guider C5,C8	**99.95**
DEC Motor C5	**89.95**
JMI Focus Motor C5	**94.95**
Carry Case with Wheels for C5/C5+	**171.95**
Piggyback Counterpoise C5	**54.95**

Celestron Reducer/Corrector f/6.3

This combination focal reducer and field corrector lens accessory works with all Current Celestron and Meade Schmidt Cassegrains. Now it is possible to have a dual focal ratio instrument without sacrificing image quality. The Reducer/ Corrector is f/6.3 for C8 and C11, f/7 for C14. A four element, fully multi-coated accessory. Results are amazing BOTH visually and photographically.

112⁵⁰

CELESTRON TELESCOPE ACCS.

AC Adpt. C5+, C8+ Ultima	**18.95**
Car Bat. Adpt. C5+,C8+ Ultima	**24.95**
2X Barlow 1.25" Short Tube	**44.95**
Counterweight Bar Assembly 8"	**89.95**
or 11"	**94.95**
Case for C8	**174.95**
Dew Eliminator	**19.95**
Piggyback Mt 8"	**34.95**
Piggyback Bar Assembly 11"	**69.95**
Dewstar/Shade 8"	**26.95**
MOTORS	
JMI DEC C8+/Classic 8	**74.95**
JMI Focus C8+/Classic 8	**89.95**
Celestron Focus Motor	**109.95**
Motor for CG-3	**74.95**
Motor for CG-4	**119.95**
Motor for CG-5	**109.95**
Dual Axis Drive for GP & CG5	**319.95**
ADVANCED ASTRO MASTER	
Advanced Astro Master for C8, Ultima-9-11	**519.95**
for G-9/GII	**569.95**
FILTERS	
LPR A	**59.95**
LPR B	**84.95**
Pol. Set 1¼"	**44.95**
Sky Filter #2	**44.95**
4 piece 1.25" FilterSet	**49.95**
Comet FilterSet	**34.95**
Glass Solar Filter 8"	**74.95**
DIAGONALS	
Diagonal Erect 1.25" 45°	**41.95**
Diagonal Erect 1.25" 90°	**49.95**
2" Mirror Star Diagonal	**134.95**
Star Diagonal 90 Degree	**39.95**
FINDERSCOPES	
9x50 Finderscope Kit	**74.95**
6x30 Finderscope Kit	**45.95**
7x50 Polaris Finder Scope with Illuminator & Bracket	**159.95**
Quick Release f/7x50 find	**42.95**
Star Pointer Finderscope	**37.95**
Polaris Axis Finder f/C4.5	**89.95**

1.25" RACK & PINION FOCUSERS	
1.25" Focuser	**32.95**
Polaris Axis Finder for C4.5	**89.95**
GUIDING SYSTEM	
Radial Guider	**99.95**
Micro Guide Eyepiece	**157.95**
10mm Plossl Reticle	**99.95**
12mm Kellner Reticle	**84.95**
20mm Cross Hair Eyepce.	**38.95**
Pulsar Illuminator	**59.95**
Standard Illuminator	**49.95**
Focus Micrometer	**114.95**
TRIPODS & MOUNTS	
Adj. Tripod Heavy Duty	**264.95**
Lightweight Tripod	**179.95**
Alt-Azimuth Mount	**149.95**
New CG-3 Equatorial Mnt.	**129.95**
New CG-4 Equatorial Mnt.	**319.95**
New CG-5 Equatorial Mnt.	**449.95**
Photo Tripod	**99.95**
Great Polaris 8" Mount. with Polaris Finder	**549.95**
Vibration Suppression Pads	**39.95**
NIGHT VISION ASTROLIGHTS	
Disposable Astrolite	**3.95**
Night Vision LED Light	**19.95**
T-ADAPTER/TELE EXTENDERS	
Tele Extender Deluxe	**48.95**
T-Adapt. f/Schmidt Cassegrains	**24.95**
T-Adapter Refractor/C4.5	**34.95**
T-Adapter/Barlow Lens 1.25"	**49.95**
T-C 16mm Adapter	**29.95**

CCD Framing Ocular only **59.95**

New! Pixel 237 CCD Camera **Call**

CELESTRON ZOOM 1¼" EYEPIECES

Deluxe zoom Ocular 6.5-18mm Ortho **145.95**

ULTIMA EYEPIECES

5mm, 1¼"	**69.95**
24mm, 1¼"	**79.95**
42m, 1¼"	**99.95**
2X Ultima Barlow Lens	**Call**
7.5, 1¼"	**69.95**
30mm, 1¼"	**84.95**
35m 1¼"	**99.95**
12.5mm, 1¼"	**69.95**
18mm 1¼"	**79.95**
Plossl 6.3,7.5,10,17,26	**44.95**
32, 40mm	**56.95**

PLOSSL EYEPIECES

6.3, 7.5, 12.5, 10, 17, 20, 26mm, 1¼"	**43.95**
32, 40mm, 1¼"	**54.95**

Vixen Lanthanum Eyepieces LV Series

2.5mm,	**127.95**
6mm,	**1072.95**
12mm	**114.95**
25mm	**124.95**
4mm	**117.50**
9mm	**109.95**
15mm	**114.95**
30mm 2"	**159.95**
5mm	**109.95**
10mm	**109.95**
20mm	**124.95**
8-24mm Zoom	**169.95**

Pentax XL SMC Eyepieces

5.2, 7, 10.5, 14, 21, 28mm, 1.25"	**Call**
40mm, 2"	**289.95**

Write or Call for a **FREE Binocular, Spotting Scope, Telescope Catalog**
Call **800-815-1259**
Ask for the Astro Catalog

CELESTRON

REFLECTORS

C-114 HD *Premium Optics, CG-4 Heavy German Equatorial Mount with Adj. Aluminum Tripod, 6x30 Finderscope, 20mm Plössl Eyepiece*	**Call**
Firstscope 114 Deluxe	**Call**
Firstscope 114 Premium	**Call**
Firstscope 76 3" Reflector	**Call**

New C-114 HD 4.5" Heavy Duty Premium Reflector

New C-102 HD 4" Fully Multi Coated Heavy Duty Refractor

STAR HOPPER Dobsonian

4.5"	**209.95**
6"	**Call**
8"	**Call**
8" Alum.	**489.95**
11"	**Call**
14"	**Call**
17.5"	**Call**
6x30 LER Finderscope	**41.95**
Accessory Kits Available at Special Prices	**Call**

REFRACTORS

New C-150 Heavy Duty 6" Reflector	**Call**
New C-102 HD *4" Fully Multi-Coated Reflector, CG-4 Heavy German Equatorial Mount with Adj. Aluminum Tripod, 6x30 Finderscope, 20mm Plössl Eyepiece*	**Call**
New C102 HD Altazimuth	**Call**
New C80 Heavy Duty	**Call**
Firstscope 80 Equatorial	**Call**
Firstscope 80 W.A. Equat.	**Call**
Firstscope 70 Alt. Deluxe	**Call**
Firstscope 70 Equatorial	**Call**
Firstscope 60 Alt. Deluxe	**Call**
Firstscope 60 Equatorial	**Call**
Firstscope 60 Equatorial with Aluminum Tripod	**Call**

SPOTTING SCOPES

C90 MC w/1.25" Eyepiece	**Call**
Ultima 65 & 80	**Call**
15-60X Zoom	**Call**
New 80mm Wide Field with 2 Plossl Eyepieces	**Call**
500 f/5.6 Spotting Scope	**Call**
f/4 Adapter for 500/5.6	**74.95**
Moon Filter .96"	**9.95**

Tele Vue®

PLOSSLS	PANOPTIC	NAGLER
8mm 1¼" ....**Call**	15mm 1¼" ......**Call**	20mm 2" ....**Call**
11mm 1¼" ......**Call**	19mm 1¼" ....**Call**	16mm 2"/1¼" .**Call**
15mm 1¼" ......**Call**	27mm 1¼" ......**Call**	12mm 2"/1¼" ..**Call**
20mm 1¼" ......**Call**	22mm 1¼" ......**Call**	13mm 2"/1¼" .**Call**
25mm 1¼" ......**Call**	35mm 2" ....**Call**	9mm 2"/1¼" ...**Call**
32, 40mm 1¼" **Call**	Panoptic Barlow Interface 2" ....**Call**	7mm 1¼" ....**Call**
55mm 2" ....**Call**	**BARLOW**	4.8mm 1¼" ......**Call**
	Short Tube 2x 1¼" ....**Call**	
	3X 1¼" ....**Call**	
	Big Barlow 2x 2" ....**Call**	

New POWERMATE 5X Image Amplifier......CALL

ACCESSORIES

Bino-View Binocular Viewer ....**Call**

STAR DIAGONAL	RICH FIELD KIT	PARACORR
2" Star Diagonal ....**Call**	with 55 Plossl 2" Diag., 2" to 1¼" Adapter **359.95**	2" COMA CORRECTOR **Call**
1.25" Star Diagonal ....**Call**		

TELE VUE REFRACTORS

RANGER
70mm ED Lightweight Scopes
Available:
Brass and Green Texture
Call

PRONTO

70mm Aperture f/6.4 with ED Glass	**Call**

101mm REFRACTORS

101	**Call**
85mm	**Call**

Tele Vue Mounts & Accessories

GIBRALTAR MOUNT Ashwood	**Call**
WALNUT PANORAMIC MOUNT with Brass Fittings	**Call**
STARBEAM ."Red Star" Projection Finder	**Call**
PIGGY-CAM Camera Adapter	**41.95**
NEW TELE-POD	**Call**
QUICK POINT Day/Night Sighting	**29.95**

SKYGAZER SERIES TELESCOPES

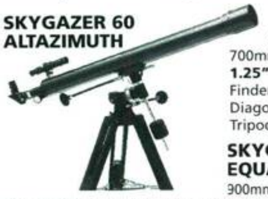
90mm SKYGAZER EQUATORIAL

Refractor Includes 3 high quaility 1.25" eyepieces (6.5, 10 and 25mm) Short tube Barlow, T-adapter, Adjustable tripod with tray, slow motion controls, 6x30 finder **399.95**

80mm Equatorial

910mm focal length (f/11.4) German Equatorial Mount, slow motion controls, setting circles, 25mm 1.25" eyepiece (36X), 1.25" diagonal, 6x30 finderscope, adjustable wood tripod .... only **284.95**

SKYGAZER 60 ALTAZIMUTH



Features a quality 700mm f/11 Refractor, **Two 1.25" Eyepieces,** 5x24 Finderscope, Hybrid 1.25" Diagonal, Adjustable Wood Tripod .... only **114.95**

SKYGAZER 60 EQUATORIAL

900mm f/15 Refractor, **Two 1.25" Eyepieces,** German Equatorial Mount, Slow Motion Cables, Setting Circles in both axes, 6x24, Finderscope, Hybrid 1.25" Diagonal, Adjustable Hardwood Tripod .... only **139.95**

Motor Drive for Skygazer 114
74.95

SKYGAZER 114
(4.5)
Equatorial Deluxe Reflector
249.95

114mm diameter Reflector with German Equatorial Mount, Slow Motion Controls in R.A. and DEC., 5x24 Viewfinder, Two 1.25" 25mm (36X) & 10mm (91X) Eyepieces, Adjustable Wood Tripod w/Accessory Tray

New EQUATORIAL MOUNT with Tripod and Slow Motion Controls (same mount as supplied w/Skygazer 114) **129.95**

New STEREO BINOCULAR VIEWER
499.95

Telescope Accessories

DEW SHIELD

Collapsible, fold down, easy to store and transport

for Celestron C90	**18.95**
f/8" Schmidt Cassegrains	**28.95**
f/5" Scopes	**24.95**
f/10" Schmidt Cassegrains	**38.95**
f/11" Scopes	**49.95**

LUMICON FILTERS

BUY ANY 2 FILTERS AND TAKE 7% OFF THESE PRICES
UHC Premium, Deep Sky Premium, H-Beta or Oxygen III

1¼"	**99.50**
2" Rear Cell	**199.95**
48mm	**199.95**
2" T Mount	**199.95**

TELRAD FINDER

TELRAD with Base	**36.95**
Dew Shield for Telrad	**11.95**
Spare Mounting Base	**7.95**

EASY TESTER

Optical Evaluation Eyepiece	**29.95**

JMI FOCUSERS

NGF-DX1	**229.**
NGF-DX2	**169.**
NGF-4	**99.**
NGF-DX3	**139.**
NGF-S w/Motofocus	**239.95**
NGF-S Mini	**189.95**
FOCUS MOTOR f/Meade LX200	**79.95**

THOUSAND OAKS SOLAR FILTER

Stainless Steel Coated (Type 2 & Type 2 Plus)
for Celestron C90's
for Televue Genesis
for Televue Pronto/Ranger
for Celestron C5's
for Schmidt Cassegrains 8"
for Meade 10"

Now Available at Greatly Reduced Prices

WE SHIP PROMPTLY. ALL TELESCOPES INCLUDE U.S.A. WARRANTY

No Surcharge for MasterCharge or Visa Purchases. Personal checks welcome, will ship without delay. Name must be imprinted on check, also include address, phone, and a copy of major credit card or driver's license for reference. Shipping, handling and insurance additional. 14 day money back guarantee less shipping, with packing and blank warranty card, except film and paper. We ship UPS. Some items special order. All orders are subject to acceptance and verification. Second hand dealer's license #802862. Pictures are for illustration purposes only and may not be exact. Wa are not authorized Meade dealers.

Prices effective till September 20, 1998 **Please address all inquiries and orders to ASTRO. DEPT. #55**

ADORAMA

42 West 18th Street • New York, NY 10011 10

ORDER TOLL FREE **800-723-6726**

ORDERS & INFO **212-647-9800**

FAX # 212-675-8715

ASTRONOMY BOOKS

Books for Beginners

Nightwatch: Equinox Guide	22.95
Astronomy: Self-Teach Guide	17.95
Guide to Amateur Astronomy	34.95
Deep Sky: An Introduction	24.95

Binocular Observing

Binocular Astronomy	24.95
Touring the Universe Through Binoculars	28.95
Deep Sky Objects	8.95
Exploring the Moon	14.95

Star Atlases

Sky Atlas 2000 Field Ed.	21.95
Laminated Sky Atlas 2000 Field Edition	59.95
Sky Atlas 2000 Comp.	24.95
Sky Catalogue 2000. Vol. 1 or 2 2nd Ed. (paperback)	39.95
Bright Star Atlas 2000	10.95
Celestron Sky Map	16.95
Atlas of Deep Sky Splendors 4th Edition	24.95
Uranometria 2000	39.95
Deep-Sky Field Guide to Uranometria 2000	49.95

Observers' Handbooks

The Backyard Astronomer's Guide	29.95
1000+: The Amateur Astronomer's Field Guide to Deep-Sky Observing	34.95
Star Hopping by Macrobert	19.95
City Astronomy	18.95
Skywatching by Levy	29.95
The Messier Album	21.95
Burnham's Celestial Handbook 3 Volume Set	39.95
Observing Handbook & Catalog of Deep Sky	49.95

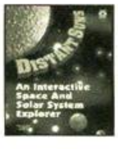
Astrophotography & Imaging

Astrophotography II	18.95
Choosing & Using a CCD Camera w/ 3.5" Disk	29.95
Introduction to Astro. Image Processing	29.95
CCD Camera Cook Book	29.95

Building Telescopes

How To Make A Telescope	19.95
Build Your Own Telescope	24.95
Starware by "Harrington"	24.95
Telescope Building w/Dobson Video Tape	39.95

ASTRONOMY SOFTWARE



Distant Suns with Mars Rover *Special!*	36.95
The Mars Explorer –	14.95
The Venus Explorer –	14.95

THE SKY
for Windows 95

Sky Level 2	Call
Sky Level 3	Call
Sky GSC (CD ROM) Level 4	Call
LX-200 Interface	24.95

New!
Red Shift 3
(PC) **46.95**
(MAC) **49.95**

MORE SOFTWARE

Deep Space (CD /DOS)	129.95
Starry Night Deluxe	89.95
Our Solar System	18.95
Spacecraft Encyclopedia	14.95
The Universe	14.95
Encyclopedia of Space & Universe	42.50
Skybase Space Station	34.95
Planetary Mission	34.95

New from Pro Optic Laser Collimator

The easiest and fastest way to precisely adjust the mirrors of your Newtonian Telescope or Cassegranian secondary for peak image sharpness and contrast Machined by hand from aluminum and stainless steel to an accuracy of 0.0002

for 1¼" focusers	115.00
for 1¼" and 2"	129.00

NIGHT VISION

BINOCULARS

30,000X 2.5X Magnification	399.95
Compact Binocular 30,000X 4X Mag.	399.95
30,000X Goggles 1X Mag. Focuses as close as 9"	574.95

MONOCULARS

5X Compact Monocular with 10,000X Light Magnification	279.95

TASCO

NV-356 **Binocular**	399.95
NV-360 **Monocular**	294.95
Camera Adapter for 360	49.95

Night Owl

- 1400x light amplification
- 2.4x image magnification with high quality large objective lens to gather light.
- Camera adapter and infrared illminator included

***Night Owl NZTI*™**

164.95

BINOCULARS

Pro-Optic

Now includes 25 YEAR WARRANTY

These binoculars with their large objectives high quality BAK-4 prisms will provide you with breathtaking wide-field observation of astronomical objects as well as terrestrial viewing under low light conditions.

Each binocular is provided with a high quality Hard Case, Neck Straps and Rubber Eye-Cups.

70mm Jumbo Fully Multi-Coated Series

11x70 Jumbo – 4º field of view, 21mm eye relief, weighs 2.8 lbs.	**169.95**
16x70 Jumbo– 3.6º field of view, weighs 2.8 lbs.	**179.95**

80mm Giant Fully Multi-Coated Series

11x80 Giant – 4.2º field of view, 14mm eye relief, weighs 5.25 lbs.	**259.95**
20x80 Giant – 3.3º field of view, 14mm eye relief, weighs 5.25 lbs.	**269.95**

100mm Ultra Giant Series

The ultra large aperture of 100mm provides more than 50% more light gathering power than the standard 80mm Giant Binoculars. For a delightful experience in astronomical viewing.

Both feature multi-coated optics, BAK-4 prism, built-in platform which mounts on a tripod.

14x100 Ultra Giant	**949.95**
25x100 Ultra Giant	**999.95**

FUJINON FMT-SX Binoculars

10x70

6x30 FMTR-SX w/Rubber Coatings & fashion strap	**Call**
7x50 FMT-SX with Carry Case & fashion strap	**Call**
7x50 FMTR-SX w/Rubber Coating & fashion strap	**Call**
7x50 FMTR-CSX R.C.with Compass & fashion strap	**Call**
8x30 FMTR-SX Rubber Coated & fashion strap	**Call**
10x70 FMT-SX with Carry Case & fashion strap	**Call**
16x70 FMT-SX with Carry Case & fashion strap	**Call**
Tripod Adapter Large	**19.95**
8x42 BFL	**229.95**
10x42 BFL	**234.95**

GIANT BINOCULARS

25x150 ED EM	**Call**
25x150 EM	**Call**
40x150 ED MT	**Call**

Fieldscope Super 80

Super 80 with 20X-60X	**Call**
Super 80 ED with 20X-60X	**Call**

LEICA w/USA Passport Warranty

10x50 BA	**Call**
8x50 BA	**Call**
New 12x50 BA	**Call**
7x42 GEOVID BDA	**Call**
7x42 GEOVID BD	**Call**

Leica Spotting Scopes

Televid 77mm Straight or Angle	**Call**
Televid 77mm ED Straight or Angle	**Call**

BINOCULAR ACCS.

Car Window Mount	**29.95**
Tripod Adapter	**16.95**

KOWA

82mm Spotting Scopes
(Body only)

TSN-821	**409.95**	TSN-822	**369.95**
TSN-823	**909.95**	TSN-824	**879.95**

82mm Scopes with 20-60X Zoom

TSN-821 with 20-60X Zoom	**639.95**
TSN-822 with 20-60X Zoom	**609.95**
TSN-823 with 20-60X Zoom	**1139.95**
TSN-824 with 20-60X Zoom	**1119.95**

CANON
Image Stabilized

10x30	**Call**	12x36	**Call**
15x45	**Call**		

PENTAX PCF

7x50	**120.00**	8x40	**120.00**
10x50	**135.00**	12x50	**137.00**
16x50	**144.00**	20x50	**160.00**

CELESTRON

GIANT MULTI-COATED

20x80 Basic	**Call**	20x80 Dlx	**Call**

REGAL

8x42	**Call**	10x50	**Call**

ED

6.5x44	**289.95**

ULTIMA SERIES

7x50	**Call**	8x40	**Call**
10x50	**Call**	8x56	**Call**
New 9x63	**Call**		

PRO SERIES w/Focus Lock

7x50	**99.95**	8-24x50	**139.95**

NEW ADVENTURER

7x50	**Call**	8x32	**Call**
10x50	**Call**	8-32x50	**Call**

MINI M/C with Case

8x21	**49.95**	9x25	**59.95**
10x25	**51.95**	7-16x25	**75.00**

MONOCULAR– 8x25	**39.95**
Telescope/Monocular	**39.95**

BUSHNELL

Discoverer 15-60 X60	**179.95**
Camera Mount f/Discoverer	**14.95**
Spacemaster	**149.95**
Spacemaster Rubberized	**163.95**
Spacemaster Kit w/15-45X, Tripod and Case	**247.95**
Elite 60mm w/15-45X Zoom	**Call**
Elite 77mm	**269.95**
Eyepieces & Accessories	**Call**

Pro-Optic
Astronomical Accessories
A unique combination of high quality and economical prices

Pro-Optic Plössl 1.25" Eyepieces

• Sharp detail • High contrast ghost-free images • Wide 50° apparent field of view (43° on the 40mm Plössl) • 4 element optics, fully magnesuim flourite anti reflection coating on each air to glass surface • Lens edges are blackened to keep out reflected light • Accepts 1.25" filters.

NEW! MULTI-COATED PLÖSSL EYEPIECES

40mm	**49.95**	32mm	**49.95**
25mm	**34.95**	17mm	**34.95**
12.5mm	**44.95**	10mm	**34.95**
7.5mm	**34.95**	6.3mm	**44.95**

40mm (Field of View 43°)	**44.95**
20mm Plössl 1.25"	**29.95**
7.5mm Plössl 1.25"	**29.95**
New! Rubber Eye Guard for 6.3-25mm plössl	**2.49**

Short Tube Barlow

Double the power of any eyepiece with this Barlow. Only 2¼" long. Works with all type of telescopes, including Refractors and Reflectors

only **$39.95**

Pro Optic 500mm f/ 5.6 Maksutov Telephoto/ Spotting Scope

with High-Tech White Finish

Pro-Optic
Nikon

Carry Case

Multi-coated to maximize contrast and sharpness and a built-in field flattener to reduce field curvature.

With its 500mm focal length, it is long enough for close-ups of far away objects but with the f/5.6 optics it is fast enough to be hand held, focuses as close as 5 feet.

With the addition of the SS500 Kit you can convert it to a 20X 90mm spotting scope. The SS500 kit includes a 45° 1.25" Erect Image Diagonal and a 25mm 1.25" Plossl

Pro-Optic 500mm f/5.6 lens	209.95
Pro-Optic SS500 Kit (when purchased w/500/5.6)	49.95
350mm f/4 Converter for 500/5.6	74.95

PRO OPTIC

New 15-45x Fieldstar Spotting Scope Outfit

Fully Coated, 2.25° f.o.v. at 15x, Long Eye Relief (33mm @ 15x) weighs only 25 oz,
• Rubber Coated includes Case & Table Top Tripod

139.95

Pro-Optic Slow Motion Control **29.95**

Make accurate slow motion adjustments in altitude and Azimuth. In addition the Pro-Optic SMC allows you to make major adjustments in elevation with a separate control knob.The Slow Motion Control fits any tripod with 1/4-20 thread.

Pro-Optic 45° Erect Image Diagonal

Provides an ideal 45° angle for erect image terrestrial viewing

Pro-Optic 45° Erect 1.25"	38.95
Pro-Optic 45° Erect Hybrid (1.25" to .96")	39.95
Pro-Optic 90° Star Diagonal 1.25"	34.95

EYEPIECE FILTERS 1.25"

Available in the following colors: 1A Skylight; 8 Yellow; 11 Yellow Green; 12 Deep Yellow; 15 Deep Yellow; 21 Orange; 23A Red; 25 Red; 47 Violet; 56 Light Green; 58 Green; 80A Lt. Blue; 82A Pale Blue; ND 0.3; ND 0.6

1.25" Ea.	**9.95**
Moon Filter 1.25" (ND 9X)	**11.95**
Buy any 4 filters (1.25")	for only **34.95**
Buy any 12 filters	for only **99.95**

4 Piece Filter Set with Pouch

Set #1 includes: #12, 23A, 58 & 80A Packaged in a Pouch	**34.95**
Set #2 includes: #11, 25A, 47 & 82A	**34.95**

SEE OPPOSITE PAGE FOR ORDERING INSTRUCTIONS

Astronomy's

Retail & Travel Directory

The Directory is designed to be a quick and easy way to locate astronomy-related retail stores, activities, planetariums and observatories. To advertise call toll free 1-888-558-1544 ext. 487.

RESORTS

IOWA - Coon Rapids 50058

GARST FARM RESORTS

Fabulous Dark Skies!
B&B • Cottages • Campsites • Trail Rides • Canoes
Mountain Bikes • Farm Tours • Buffalo
Guided Astronomy Tours & Telescopes For Rent.
Reservations Required. www.farmresort.com
1390 Hwy 141 **(712) 684-2964**

TEXAS - Alpine 79830

TERLINGUA RANCH RESORT

Some of the darkest skies in the United States!
Remote, Quiet & Beautiful!
Adjoins Big Bend National Park.
Two hours from McDonald Observatory.
Cabins, RV Sites & Camping. For information:
HC 65 Box 220 **(915) 371-2416**

RETAIL SHOPS

ARIZONA - Phoenix 85032

THE ASTRONOMY SHOPPE

- Telescopes:
Meade, Celestron, Tele Vue®, Orion, Takahashi
- Spotting Scopes • Binoculars
- Eye Pieces & Accessories
- Maps • Books
- Sky Tours

3202 E. Greenway Rd. Suite 1615 **(602) 971-3170**

ARIZONA - Tucson 85711

STELLAR-VISION & ASTRONOMY SHOP

TUCSON'S COMPLETE ASTRONOMY SHOP!
-SINCE 1986-
- New & Used Equipment
- Meteorite & Meteorite Jewelry
- Books - Posters - Maps & Star Charts
- Custom Work - Machine & Wood Shop Work
- Observatory Construction & Repair
- Observing Site & Tour Guides Available
- Rental Equipment Available - call for details
- Repair Work - Telescope Cleaning & Collimating

Credit Cards Accepted. 90 Days same as cash
http://www.theriver.com/stellar_vision
1835 S. Alvernon #206 **(520) 571-0877**

Say you saw their ad in the Retail & Travel Directory!

FLORIDA - Sarasota 34236

WOLF CAMERA

WOLF CAMERA

Telescopes
Meade
Celestron
Tele Vue®

CCD Equipment
Meade Pictor
Optec Max.
Accessories

The Largest Telescope Dealer in the Southeast! New & used telescopes, CCD equipment & accessories, plus a huge selection of eyepieces and binoculars! Call Chuck Pisa our staff Astronomer with 20 years experience today!
www.wolfcamera.com Fax: (941) 952-0278
1055 S. Tamiami Trail **(941) 957-4686**

RETAIL SHOPS

GEORGIA - Atlanta 30306

Camera Bug Ltd.

Telescopes • Binoculars • Accessories • Eyepieces
Spotting Scopes • Maps • Books • Canon • Celestron
Meade • Minolta • Olympus • Orion • Pentax • Tele-Vue® We ship almost anywhere! www.camerabug.com
fax:(404)873-3925 *ORDERS ONLY*: (800)545-8509
1799 Briarcliff RD **(404) 873-4513**

NEW MEXICO - Belen 87002

NEW MEXICO ASTRONOMICAL

BEFORE YOU BUY... COME TO THE COUNTRY
AND TEST EQUIPMENT UNDER DARK SKIES!
Full range of sizes on display!
Telescopes • Eyepieces • Mounts • Accessories
Meade • Tele Vue® • Parks Optical • Unitron • Celestron
834 N. Gabaldon Rd. **(505) 864-2953**

NEW YORK - Amityville 11701

BERGER BROS.

CAMERA & VIDEO EXCHANGE
"Serving New York For 50 Years!"

TELESCOPES • BINOCULARS • CAMERAS
CAMCORDERS • DIGITAL CAMERAS
We Carry: Celestron • Bausch & Lomb • Nikon • Canon
Meade • Pentax • Minolta • Olympus • Leica • & More!
Catalog Available • We Ship Worldwide
http://www.berger-bros.com Fax: (516) 264-1007
209 Broadway (Route 110) **(800) 262-4160**

NEW YORK - Garden City 11530

NEPTUNE PHOTO

DISCOUNT PRICES on the finest in telescopes, spotting scopes, cameras, binoculars, video & AV equipment including Bausch & Lomb, Canon, Celestron, Leica, Meade, Minolta, Nikon and Pentax.
Fax: (516) 741-1225 1-800-955-1110
827-829 Franklin Ave. **(516) 741-4484**

PENNSYLVANIA - Huntingdon Valley 19006

OPTICAL GUIDANCE SYSTEMS

Custom-Made Ritchey – Chretien, Classical
Cassegrain and Newtonian telescopes 10-32 inches.
World's #1 selling line of Ritchey - Chretien Optics
http://www.nb.net/~ogs
2450 Huntingdon Pike **(215) 947-5571**

TEXAS - San Antonio 78250

Analytical Scientific

"The Source For All Your Astronomy Needs" TM

Telescopes:
Schmidt-Cassegrain • Refracting • Meade • Maksutov
Dobsonian • Celestron • Tele Vue® • Bushnell • JMI
Binoculars • Spotting Scopes • Laser Sight:
Celestron • Selsi • Swift • Bushnell • Meade
Microscopes: Swift • Eagle • MBC
EMAIL: analyticalscientific@compuserve.com
http://Astro-Mall.com Fax: (210) 520-3344
11049 Bandera Rd. **(210) 684-7373**

RETAIL SHOPS

WISCONSIN - Middleton 53562

EAGLE OPTICS

Celestron, Meade & Tele Vue®
Telescopes & Accessories in stock!
Shipping Nationwide!
Discount Price List & Comprehensive Catalog.
www.eagleoptics.com
2120 W. Greenview Dr. #4 **(800) 289-1132**

CANADA - Manitoba - Neepawa R0J 1H0

STAR GAZER INSTRUMENTS

- Telescopes • Binoculars • Accessories • Books
- Celestron, Omcon • Astro-Systems, Tele Vue®
- 1000 Oaks and more!
- Call or write for free catalog
- Canada-wide delivery

Box 1851 **(204) 476-3855**

CANADA - Ontario - Toronto M6A 3A4

EfstonScience

SERVING OBSERVING SINCE 1970!

Just look for the giant telescope on our roof!

MEADE APD **CELESTRON**

Science & Astronomy Superstore.
All major brands on display. Free Literature.
We welcome trade-ins, buy used, do service.
Dobsonians in stock: 6" - 17 1/2"
www.efstonscience.com Fax: (416) 787-5140
3350 Dufferin St. **(416) 787-4581**

CANADA - Ontario - Toronto M6A 2T2

KHAN SCOPE CENTRE

MEADE APD PRODUCTS

Our 12th Year!

We Ship!
New and Used
Trade - Ins

Meade • Celestron • Tele Vue ® • Omcon • Optec
B&L • JMI • Swift • Leica • Kendrick • Antares
Canon • Swarovski • Lumicon • SBIG • Fujinon • Telrad
Thousand Oaks • Sky Publishing • Speers-Waler
and many others!
FREE DISCOUNT PRICE LIST
Visit our web site: www.khanscope.com
e-mail: khan@khanscope.com *Fax:* (416) 783-7697
3243 Dufferin St. **(416) 783-4140**

CANADA- Ontario - Burlington L7L 2A4

SKY OPTICS

Telescopes, binoculars, eyepieces, CCD's, & accessories.
Lowest prices, expert advice, Canada delivery.
Meade, Tele Vue®, Celestron, SBIG, Lumicon,
Kendrick, Software Bique, & more!
http://worldchat.com/commercial/skyoptics/
4031 Fairview St. **(905) 631-9944**

Call 1-888-5581554, ext. 487 for advertising information.

STAR PARTIES/EVENTS

GEORGIA- Atlanta 30306

OUT & ABOUT TRAVEL

SOLAR ECLIPSE 1999. AUSTRIA/HUNGARY
August 6-15, Vienna - Budapest
1699.00 dbl per person. Limited space!
1-800-914-8232
http://members.aol.com/ecli99
587 Virginia Ave. Suite 3A (404) 892-8998

Astronomy's Classifieds

This section is open to anyone who wants to buy astronomy-related merchandise. *RATES:* $1.44 per word. Minimum charge is $14.00 per issue. Prepayment required. Frequency discounts available. All copy is set in standard typography. *CLOSING DATE:* 5th of the month, three months before the cover date (i.e., March 5th for the June issue). Send your ads to *Astronomy*, Classifieds, PO Box 1612, Waukesha, WI 53187-1612. 1-888-558-1544 ext. 815. MasterCard-VISA-American Express-Discover.

ACCESSORIES FOR SALE

Equatorial platform kits. New Altazimuth platform finds and tracks objects. PC autoguiding for astrophotography. Binocular viewer kits. TL Systems, 2184 Primrose Avenue, Vista, CA 92083. (760) 599-4219. tlsystem@ix.netcom.com or http://www.netcom.com/~tlsystem/

Meade Telescope baseball caps & coffee mugs. Switzer Technologies, PO Box 570, South Holland, IL 60473.

BOOKS AND PERIODICALS FOR SALE

UFO Sightings, X-Files, Aliens. Previously classified government documents reveal truth. Free info! Write: Aliens, PO Box 4852, PVP, CA 90274.

SERVICES

Pat Baker's Astronomy Central. The finest Astronomy link page on the Internet. Web address: http://www.execpc.com/patrickbaker

TELESCOPES FOR SALE

Meade 10" LX200 new, unopened box. $3,100.00. Will pay to ship in U.S. Call (860) 659-1783 or contact 73170.1503@compuserve.com

Meade 8" f/10 LX50 w/ Magellan II upgrade. Very new, easy to use, 4-speeds, and 12,218 objects in database. Ready to sell, $1800.00 or best offer. (760) 345-2363.

TELESCOPES WANTED

Wanted: no- longer- used telescopes, parts and accessories. Contact Gary Hand, 24045 Sugarcane Ln., Gaithersburg, MD 20882. (301) 482-0000 evenings.

As powerful as the Hubble Space telescope, so is your classified ad in **Astronomy!**

Increase sales with an easy, cost-effective, classified ad.

To place your ad, call today.

1-888-558-1544, ext. 815

Astronomy®

Add your ad to the Internet!

*Reach your potential customers on the WorldWideWeb, 24 hours a day, 365 days a year! Advertise online with **Astronomy** classifieds.*

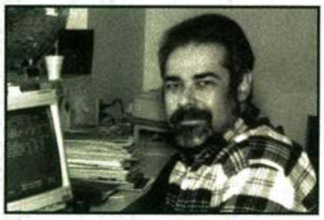
Now featuring online classified ads for as little as **$5.00***

**Special rate offered in conjunction with regular print ad.*

Contact A. Blunt at
1-888-558-1544, ext. 303
E-mail: ablunt@kalmbach.com

http://www.astronomy.com

"We believe our **Astronomy®** advertising and new location will make for a fine, profitable relationship."



Pocono Mountain Optics
2580 S. Decatur Blvd., Ste. 3
Las Vegas, NV 89102
1-800-635-3607
poconowest@aol.com
Fax: 702-252-7130

"We've been in business for 11 years with much success," says Glenn Jacobs, owner of Pocono Mountain Optics. "In fact, we just opened a new store in Las Vegas to better service our West Coast customers. We advertise with *Astronomy* Magazine to get our new location and phone number to the amateur astronomy market."

Pocono Mountain Optics supplies binoculars, telescopes, and other optical accessories to amateur astronomers around the world. "We currently manage two stores, one on each coast, and a worldwide mail order operation. *Astronomy* has helped us tremendously along the way by reaching both novice and experienced amateur astronomers. We believe our *Astronomy* advertising and new location will make for a fine, profitable relationship."

Pocono Mountain Optics is also located in Moscow, Pennsylvania.

Advertise in ***Astronomy!***
For more information call toll free:
1.888.558.1544
Outside the U.S. and Canada call 414-796-8776

Advertising Sales Manager
Dan Koehler, ext. 628

Advertising Sales Rep.
Michael Ellis, ext. 636

Retail and Travel Directory
Scott Redmond, ext. 487

www.astronomy.com

2719-0810

NEXT month in Astronomy

Jason Ware

ON THE TRAIL OF PLANETARY DISKS

As new techniques help astronomers peer deep into the galaxy, they have found dusty disks surrounding many stars. Could these be the cradles of planets?

INSIDE THE CRAB

A supernova nearly a millennium ago gave birth to the Crab Nebula, a high-energy laboratory that still fascinates astronomers.

SUPERNOVA PROBES

White dwarf stars that exploded billions of years ago suggest a chilling fate for a universe that will expand forever.

GET READY FOR A LEONID STORM

Earth will pass through a swarm of cometary debris in November, producing perhaps the best meteor storm in 33 years.

To get your copy of the November issue, visit your local hobby shop or newsstand, or call

1-800-533-6644

Kalmbach Publishing Co., P.O. Box 1612,
Waukesha, WI 53187-1612

Visit our web site at
www.astronomy.com

AD INDEX

APD Cryogenics Inc 20
A TECH 29
Adirondack Video Astronomy 111
Adorama 120, 121, 131
All Aboard Travel 110
Anacortes Telescope & Wild Bird 131
Analytical Scientific 131
Aras Tours, Inc. 40
Arcron Zeit 40
Astro Haven 110
Astro-Physics 41, 115
Astronomics 103, 119
Astronomy Shoppe 131
Ball Aerospace Technology 29
Ballantine Books 21
Beigle/Bryant Engineering 115
Bethany Sciences 112
CC Sales/Camera Corner, Inc. 36, 131
Camera Bug 131
Captain's Nautical Supplies 131
Michael I. Casper Meteorites 111
Celestron International 66, 67, 78,79
Coulter Optical 41
Cruise Holiday 110
D-Data Inc 103
Douglas Cook Inc 110
Eagle Optics 131
Edmund Scientific Company 17
Edward R. Hamilton Bookseller 111
Equatorial Platforms 114
Enchanted Skies Star Party 20
FC Meichsner Company 20, 131
Focus Camera 86, 87
Fujinon 97
Howard Glatter 112
Innovations in Travel 114
Into the Wind/The Kite Source 115
J.A.S.E.N. Enterprises 111
JMB, Inc 36
Jim Kendrick Studios 40
Jim's Mobile Industries 31
Kalmbach Publishing Co. 18, 27, 96
.... 109, 118, 123, 124
Krollkraft 113
Learning Technologies Inc 115
Lesueur Manufacturing Co. 117
Lumicon 100, 101, 131
Mag One Instruments 115
Marketplace Pages 110, 111, 112, 113, 114, 115
Meade Instruments Corp 2, 3, 7, 8, 9,
.... 10, 11, 12, 13, 134
Minerva Press 113
Montrose Travel 115
Mountain Skies Astronomical Society 113
Murnaghan Instruments 41
New England Meteoritical 114
Newbridge Communications, Inc. 19
Newport Glass Works 112
Nisur Systems 111
Novagraphics 112
Obsession Telescopes 115
Oceanside Photo & Telescope 36, 131
Optic-Craft Machining Company 111
Orion Telescopes & Binoculars 22, 23, 37, 105
Roger Paskvan 115
Pocono Mountain Optics 38, 39, 131
Psignologic Services 111
QSP Optical Technology, Inc. 114
RVR Productions 115
Radio City 113
Rainbow Optics 111
Rainbow Symphony 113
Retail & Travel Directory 122, 123
Rex's Astrostuff 112
Rivers Camera Shop 103, 131
SETIQuest 110
Samy's Camera 35
Santa Barbara Instrument Group 33
Science Connection, Inc. 114
Scope City 97, 131
Shutan Camera & Video 107
Sienna Software 20
Sky Valley Scopes 114
Sky Watchers Inn 113
Smithy 114
Software Bisque 25
Software Systems Company 21
Southern Stars Software 21
Sovietski Military Collection 113
Spectra Astro-Systems 117
Stanley Development Co. 110
Stargazer Steve 113
Starmaster Portable Telescope 114
Starsplitter Telescopes 112, 115
Stellar Vision 131
TNT Binocular Mounts & Beyond Ltd 110
Technical Innovations 36
Tele Vue Dealer Page 131
Tele Vue Optics, Inc 132, 133
Telescope Engineering 112
Travel Quest 115
Travel Wizard 112
Tropical Sails 112
Roger W. Tuthill, Inc. 35, 109, 114
Twilight Tours 113
University Optics, Inc. 115
Vernonscope 114
Virgo Astronomics 114
W B Hunt Co., Inc. 131
What in the World 21
Wholesale Optics 109
Willmann-Bell, Inc. 111
Woodland Hills Camera 131

HOT SHOTS

A collection of your images and observations

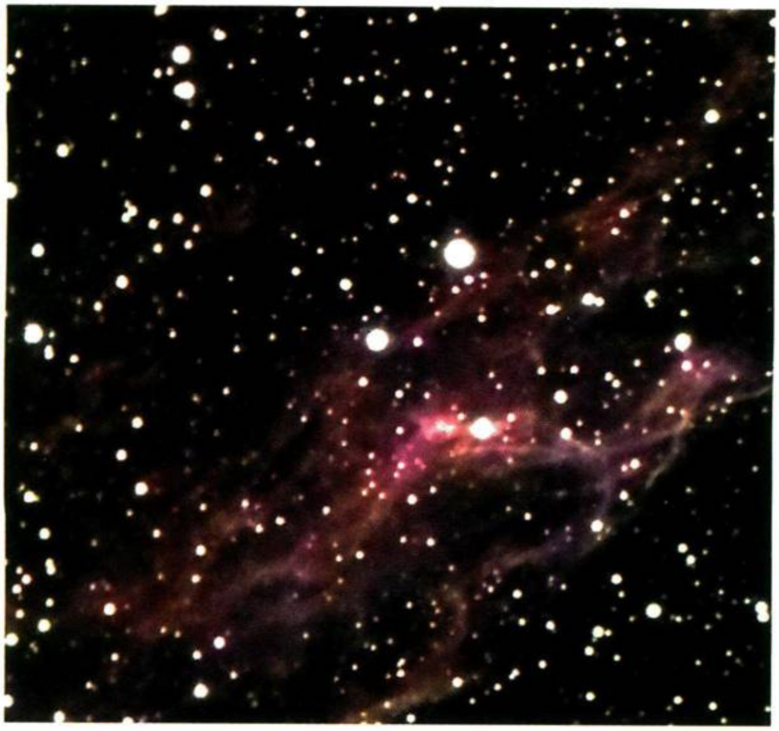
SOUTHERN MIGRATION

On the Go in South America

This observer made his vacation a star-filled extravaganza.

▶ Ah, the Holy Grail of the southern heavens! It has long beckoned this northern amateur living at 50° N, where one can seldom observe anything much below the Teapot or Corvus.

Finally preparing to journey to South America this past spring, I eagerly packed my 7x50mm binoculars. Unfortunately, I wasn't



The Veil Nebula

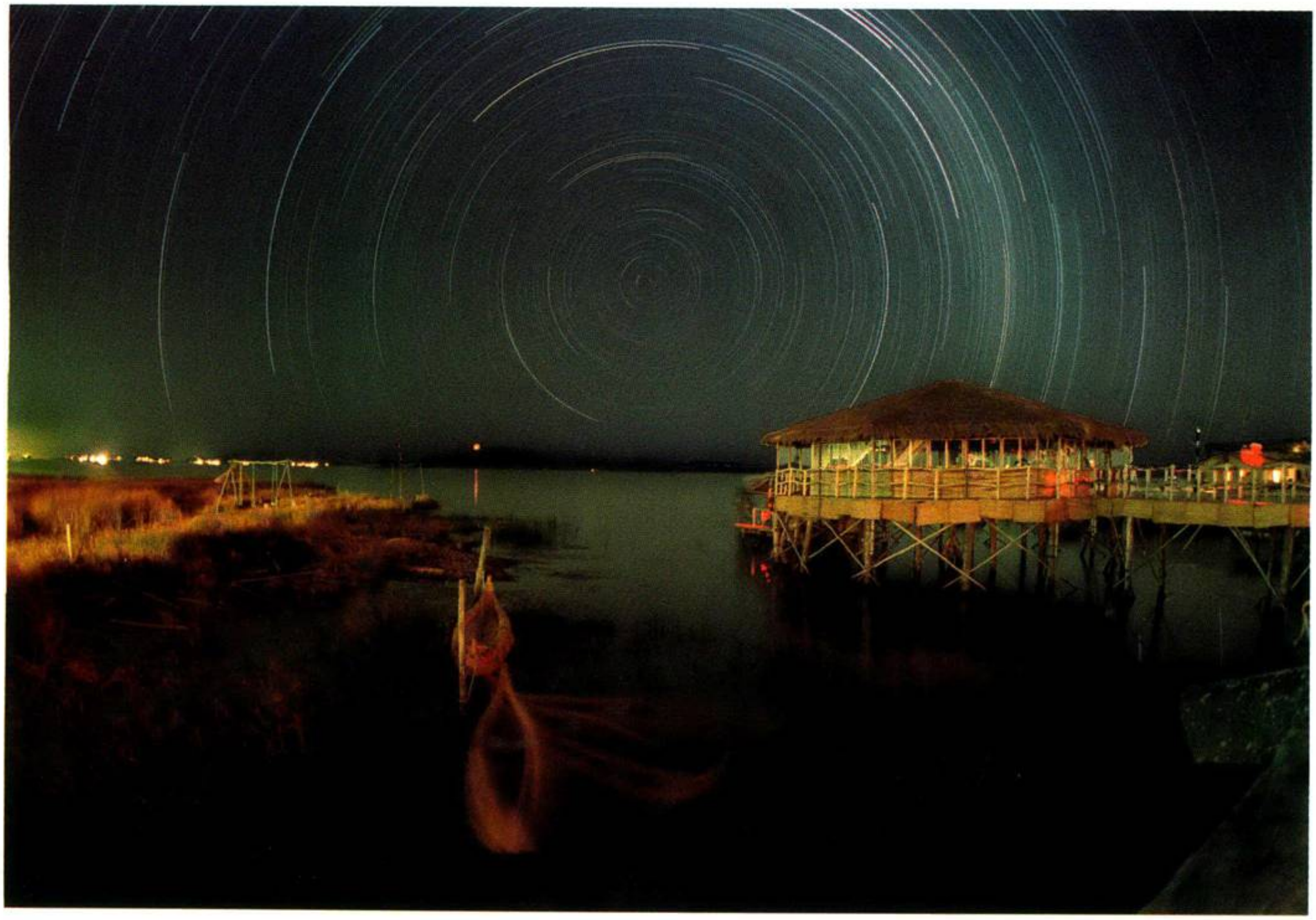
ROBERT DALBY

(10-inch f/6.3 SCT, composite of two CCD images — one low-resolution color image, Starlight XPress CCD camera, 5-minute exposure, and one high-resolution monochrome image, SBIG ST-7 CCD camera, 15-minute exposure)

The Southern Pole Rotates above Lake Titicaca in Bolivia

VIC WINTER AND JENNIFER DUDLEY

(16mm lens at f/2.8, Fuji 100 film, 4-hour exposure)



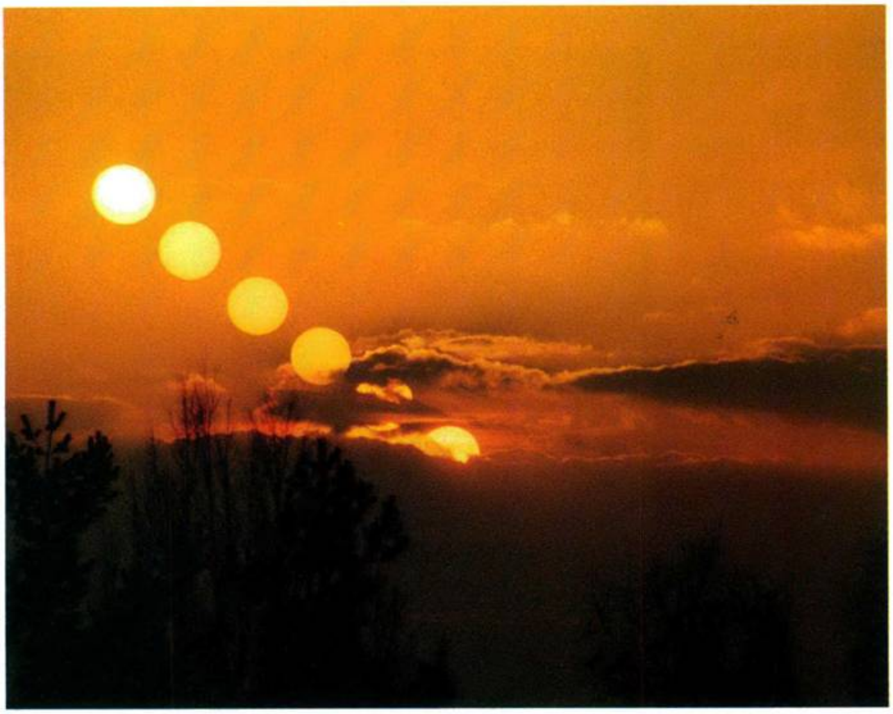
heading for the Atacama Desert, but rather toward cities in Chile and Argentina where I knew to expect urban light pollution.

Undeterred on arrival in Chile, I got a south-facing room on an upper story of my hotel (the Libertador) on the Alameda, the broad street of Santiago. To my delight, clear skies prevailed for several nights, and I got an exciting overview of the southern stars I'd looked forward to seeing for so many years. The sky was not as smoggy as I had expected, and I was able to make out asterisms and the essential highlights of some 15 constellations previously hidden from view in my home of Canada. I watched them intently from dusk until dawn as they pivoted the south celestial pole.

What a thrill to behold for the first time Achernar at the end of the river of stars below Acamar. Then on to the Southern Triangle, the Jewel Box in Crux, the False Cross, Vela's Sail, Omega Centauri, Eta Carinae, and other treasures nestled in or near the dazzling southern Milky Way.

My next hotel room in the beautiful Argentinian town of San Carlos de Bariloche faced south, but a polluting street light marred the view and drove me down to the *muelle* (docks) where I spent two clear nights locating the south polar star Sigma Octantis, 47 Tucanae, and the Coal Sack while peering north across Lake Huapi at the reversed and upside down view of Taurus, Orion, Gemini, Leo, Corvus, and the Summer Triangle, suddenly difficult to recognize from this disorienting viewpoint.

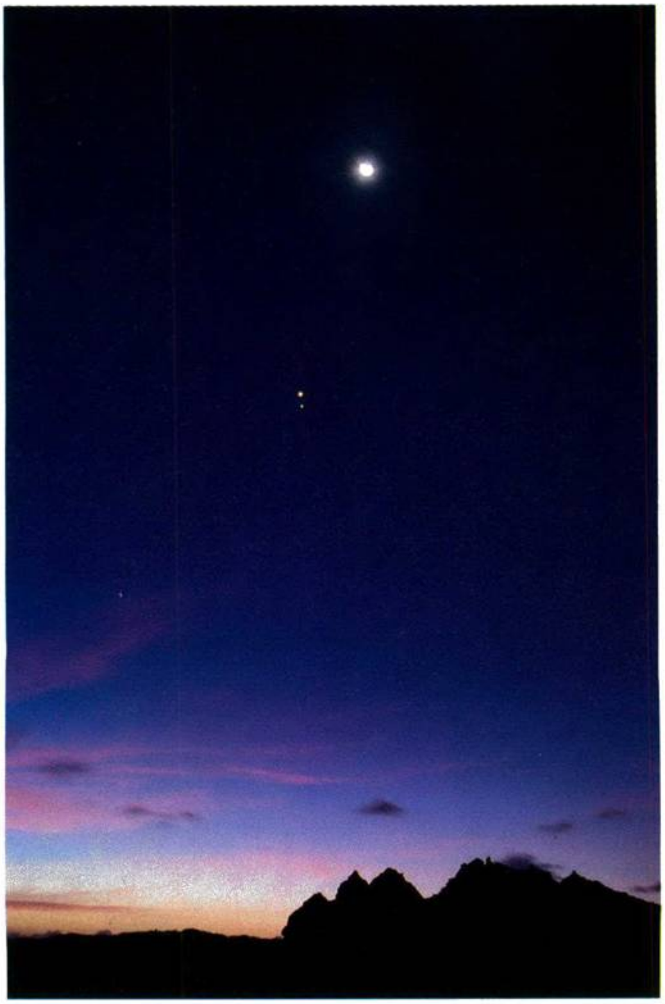
I lucked out again in Buenos Aires, where the



Sunset through the Clouds

ALES KOLÁR

(200mm lens at f/8, Konica VX 100 film, series of six photos three minutes apart; first four, 1/1000-second exposures, fifth, 1/500-second-exposure, last, 1/2000-second exposure)



Dawn's Moon, Venus, and Jupiter at Ascension Island

OLIVIER STAIGER

(35mm lens at f/8, Fuji Provia 100 film, 17-second exposure taken April 22, 1998)

Antares Region

GERALD RHEMANN AND FRANZ KERSCHE

(Kodak Pro Gold 400 film, composite of two 50-minute exposures)

central Tres Sargentos Hotel afforded me a high and fairly unobstructed southern window — on three partly cloudless nights I corraled the last of my 24 southern constellations and 19 Caldwell Catalog objects.

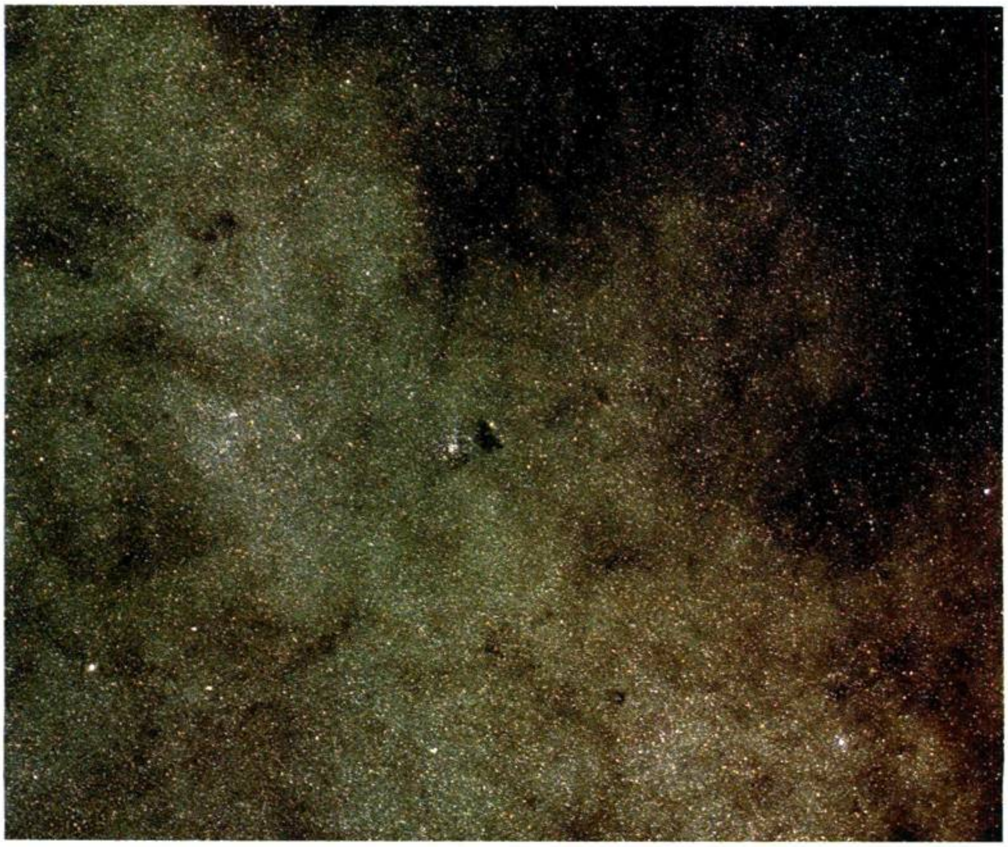
I also had breathtaking views of the Large and Small Magellanic Clouds from the Boeing 767 cockpit en route south over Brazil — wondrously clear at 35,000 feet above the clouds. Also, the brilliant display of southern stars from the window of an overnight bus crossing the Patagonian Desert (talk about inky-dark skies with nary a light between remote towns) was spectacular. The stars are truly a moveable feast . . .

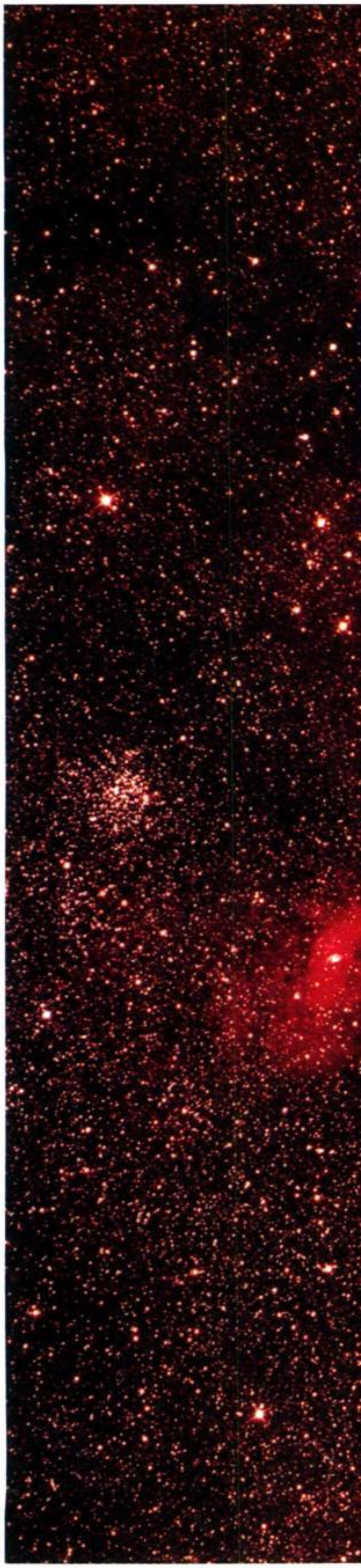
Louis Prefountaine is an amateur astronomer who calls Canada home.

M41 and Sirius
DEAN DRUMHELLER
(135mm lens, 10-minute exposure)

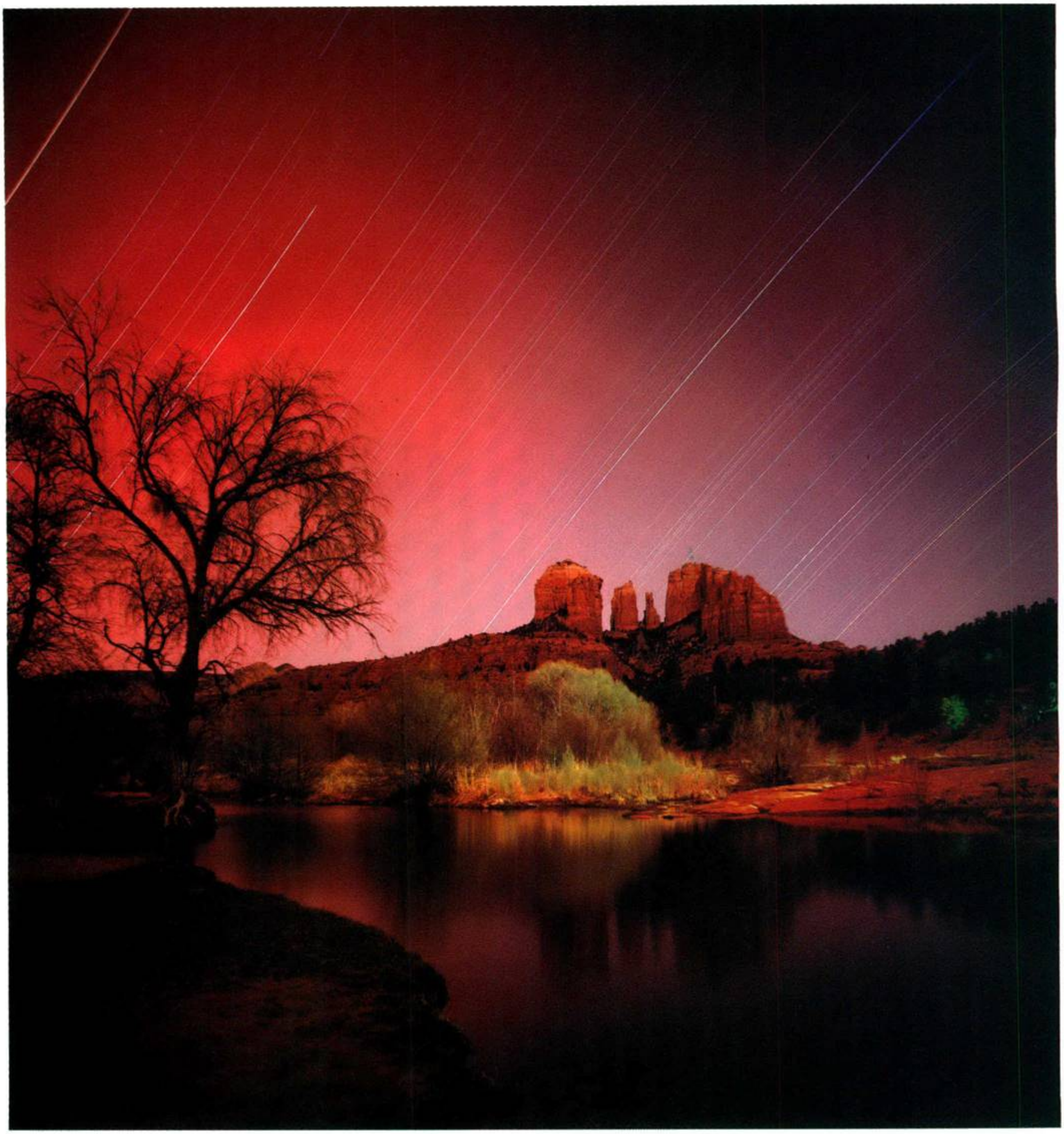
M52, NGC 7635, NGC 7538, SH 2-155, and IC 1470
JASON WARE
(12-inch f/2.2 Schmidt camera, Ektachrome 25 medium format film, composite of two 17-minute exposures)

Starfield in Sagittarius (NGC 6520 and Barnard 86)
CARL AND CHRIS WEBER
(6-inch f/7 refractor, hypered Kodak Pro 400 PPF film, 50-minute exposure)





This month's best astrophoto



Aurora and Star Trails in Sedona, Arizona

MICHELE BREEDLOVE

(210mm lens at f/8, Kodak Ektachrome 200 film, 9½-hour exposure taken March 13, 1989) Sedona is famous for its beautiful vistas and colorful rock formations. Although it is unusual for aurorae to be seen so far south, the photographer got lucky during an extraordinarily long exposure)

TELE VUE DEALERS

VISIT THE
Tele Vue® WEB SITE
http://www.televue.com

ARIZONA

The Astronomy Shoppe
YOUR LOCAL TELE VUE® DEALER
3202 Greenway Rd., Suite 1615
Phoenix, AZ 85032
602-971-3170

Quality *Tele Vue®* Products
Stellar-Vision & Astronomy Shop
• New and Used Equipment • Sales and Service
1835 S. Alvernon #206 • Tucson, AZ 85711
(520) 571-0877
SINCE 1986
http://www.theriver.com/stellar_vision

CALIFORNIA

Tele Vue® Optics Specialists!
OPT Oceanside Photo & Telescope
1024 Mission Ave.,
Oceanside, CA 92054
800-483-6287 • email: opt@optcorp.com
(760) 722-3348 • http://www.optcorp.com

Complete Line of Quality
Tele Vue® Products
Scope City
World's Largest Centers - EXPERT HELP.
Mail order: P.O. Box 440, Simi Valley, CA 93062
TEL: (805) 522-6670 • Fax: (805) 582-0292
Catalog Package $7 (refundable with purchase). Free price list.

NEW STORE

SIMI VALLEY,CA
730 Easy St.
Simi Valley, CA 93065
TEL:(805) 522-6646

SHERMAN OAKS,CA
14324 Ventura Blvd.
TEL:(818) 789-5805

LAS VEGAS, NV
4825 W. Flamingo Rd.
TEL:(702) 947-2673

COSTA MESA,CA
COSTA MESA, CA
3033 S. Bristol
TEL:(714) 957-6900

SAN DIEGO,CA
4766 Clairemont
Mesa Blvd.
TEL:(619) 277-6686

BUY • SELL • TRADE • SERVICE

Tele Vue® PANOPTIC™

15mm - 1-1/4"	$215
19mm - 1-1/4"	$245
22mm - 1-1/4"/2"	$285
27mm - 2"	$335
35mm - 2"	$365

68° Widest Field
LUMICON
2111 Research Dr. #4-5
Livermore, CA 94550
1-800-767-9576

WOODLAND HILLS CAMERA
FEATURING TELE VUE®
Eyepieces, Spotting Scopes, and Telescopes
at low, low prices!
Complete line in stock with excellent service.
Toll Free for Orders: 888-427-8766
Information: 818-347-2270 • Fax: 818-992-4486
5348 Topanga Canyon Blvd., Woodland Hills, CA 91364
BUY SELL TRADE

GEORGIA

Atlanta's Leading **Tele Vue®** Telescope and Binocular Dealer. We Ship Practically Anywhere.
Camera Bug Ltd.
1799 Briarcliff Rd. • Atlanta, GA 30306
(404) 873-4513 • FAX (404) 873-3925
ORDERS ONLY 800-545-8509
cam_bug@msn.com

MASSACHUSETTS

Hunt's Est. 1889
Photo & Video
100 MAIN ST., MELROSE, MA 02176
Call for Astronomical savings on Tele Vue®
1-800-924-8682

If you're looking for New England's oldest, most experienced Tele Vue® dealer, you've found it.

- Most Tele Vue scopes, accessories, and eyepieces in stock
- Antique optics
- Used equipment
- Trade-ins
- 78 years of experience
- Boston showroom
- Helpful staff
- Low prices
- Rental equipment
- Order by mail or phone

F. C. Meichsner Co., Inc.
182 Lincoln Street, Boston, MA 02111
(800) 321-VIEW! (8439)

NEVADA/PENNSYLVANIA

AMATEUR ASTRONOMERS...
VISIT EITHER OF OUR TWO FULLY STOCKED SHOWROOMS AND SEE THE COMPLETE TELE VUE LINE ON DISPLAY !

From Ranger to the TV-101, From Plossls to Naglers, we have it all on display & in stock.

We ship everywhere and welcome mail and phone orders.

✸ Two showrooms to better serve you. ✸

Pocono Mountain Optics
104 NP 502 Plaza
Moscow, PA 18444
Orders: (800) 569-4323
Info: (717) 842-1500
Fax: (717) 842-8364
E-mail us at:
pocmtnop@ptdprolog.net

Pocono Mountain Optics

Pocono West Optics
2580 S. Decatur #3
Las Vegas, NV 89102
Orders: (800) 635-3607
Info: (702) 252-7200
Fax: (702) 252-7130
E-mail us at:
poconowest@aol.com

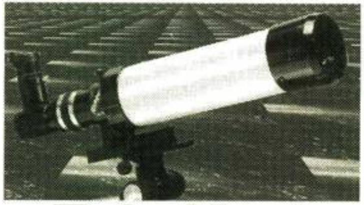
Special of the month: 5x Powermate
Mention this ad for a special price.
See our ad on pages 34 & 35

NEW HAMPSHIRE

All Tele Vue® Eyepieces In Stock.
Rivers **CAMERA SHOP**
Personalized Service Since 1930
NO SALES TAX
454 Central ave. Dover NH 03820
(800) 245-7963

NEW YORK

ADORAMA
42 West 18th Street • New York, NY 10011
ORDER TOLL FREE 800-723-6726 ORDERS & INFO 212-647-9800
FAX # 212-929-9013
Our Sales staff, dedicated to astronomy can help with your purchase



Tele Vue®
Full line of TeleVue eyepieces and telescopes in stock and on display including the new Ranger

NORTH CAROLINA

Your quality **Tele Vue®** dealer in North Carolina
CC Sales / Camera Corner
Phone: 1-800-868-2462
Fax: (336) 222-8011
2273 S. Church St., Burlington, NC 27215
email: sky@camcor.com

TEXAS

Analytical Scientific™
"The Source For All Your Astronomy Needs"
A whole new way to explore the Universe
AUTHORIZED TELE-VUE DEALER
11049 Bandera Rd., San Antonio, TX 78250
Info: (210) 684-7373 • fax: (210) 520-3344
Toll Free Order Line: 1-800-701-STAR (7827)
http://www.rahul.net/astro-mall

WASHINGTON

Anacortes Telescope & Wild Bird
3202 Commercial Avenue
Anacortes, WA 98221
PH (360) 588-9000
FX (360) 588-9100
http://www.buytelescopes.com
ANACORTES Telescope & Wild Bird
We stock every Tele Vue® product.

Captain's Nautical Supplies
-EST. 1897-
Complete line of Tele Vue® telescopes and eyepieces.
Expert optical instrument repair.
2500 15th Avenue W.
(1 mile South of the Ballard Bridge)
Seattle, WA 98119
Phone: (206) 283-7242 • 1-800-448-2278
FAX: (206) 281-4921

WISCONSIN

EAGLE OPTICS®
Complete selection of
Tele Vue®
eyepieces & telescopes
shipping nationwide
2120 W. Greenview Dr. #4
Middleton, WI 53562
(800) 289-1132 FAX (608) 836-4416
http://www.eagleoptics.com

"even better than you imagined!"

NAGLER

82° — "Space out" with Al

The "spacewalk" eyepiece! Patented & tested to be the best! Fully multi-coated, eyeguards. 20, 16, 13, 12, 9, 7, 4.8mm

NEW! EQUALIZER

The Schwartzenagler Adapter

Ordinary 2" to 1-1/4" adapters wouldn't dare mess with our 12 oz. solid bronze hero! Fights the evil balance foe who rears his head when changing from heavy to light eyepieces. Equalizer features a captive lock-screw, safety undercut and identifiable bright finish.

RICH FIELD KIT

SCT owners—Get Rich Quick!

No gimmicks. Maintain the optical integrity of your scope and increase its field area by 3 times with our Rich Field Kit. The kit includes adapters, 2" diagonal and 55mm Plössl for maximum true field. Use the 35mm Pan. & 20mm N2 too!

BINO VUE

Cyclops Need Not Apply

Bino Vue features in-line viewing for terrestrial and astronomical observing, no focus shift during inter-ocular adjustment, large, multi-coated prisms and Tele Vue quality control. Dramatically transforms any scope!

PANOPTIC

68° — aka "Nagler-lite"

Tack-sharpness and exceptional contrast fill your field! 68 deep sky degrees and fully multi-coated. 35, 27, 22, 19 & 15mm

POWERMATE

5X.......Pump up the Power

The 5X POWERMATE gives any scope BIG power, yet stands less than 3" out of your focuser - and it's parfocal. How? Al Nagler's NEW 4-ELEMENT CONCEPT, continuing the tradition of full-field sharpness with COMPLETE aberration control. Enjoy, for example, the sharpness and eye-relief of the 22mm Panoptic at 4.4mm! Of course, Tele Vue touches such as full multi-coating, filter threads, captive lock screw and 100% Q.C. at f/4 ensure your satisfaction. Call your favorite Tele Vue dealer TODAY and get powered up tonight!

UE® 5X POWERMATE™

PLÖSSL

50°- Mr. P Would be Proud

Preferred Plössl in S&T comparison review. Fully multi-coated, patented Nagler design. 55, 40, 32, 25, 20, 15, 11, 8mm

NEW! TELE-POD

Earth & Sky Travel Tripod

This 7lb. tripod is for those on the go! Perfect for Pronto and Ranger. We've created a new yoke & cradle head with built-in azimuth bearing, and combined it with aluminum legs for a great mix of stability and portability. The Alt/Az head also fits any standard photo tripod.

FINDER

Didn't Know She's Missing

Star-hop across the sky with Starbeam and Qwik-Point "red-dot" finders. Starbeam features a large 40mm lens, variable brightness, elegant design and all metal construction. Qwik-Point offers day & variable night brightness, light weight & exceptional value.

For the past 20 years Tele Vue has proudly offered quality astronomical equipment to amateur astronomers. Design revolutions: "Nagler" eyepieces, true Multi-Purpose telescopes and now Powermate to name a few, combine with exceptional quality control and knowledgeable service to create an ownership experience "...even better than you imagined."

Tele Vue® Dept A, 100 Route 59, Suffern, NY 10901 (914) 357-9522 www.televue.com, literature $3

RANGER & PRONTO

by **Tele Vue**®

Photo of Horsehead Nebula taken with Pronto by Ralph Sieger

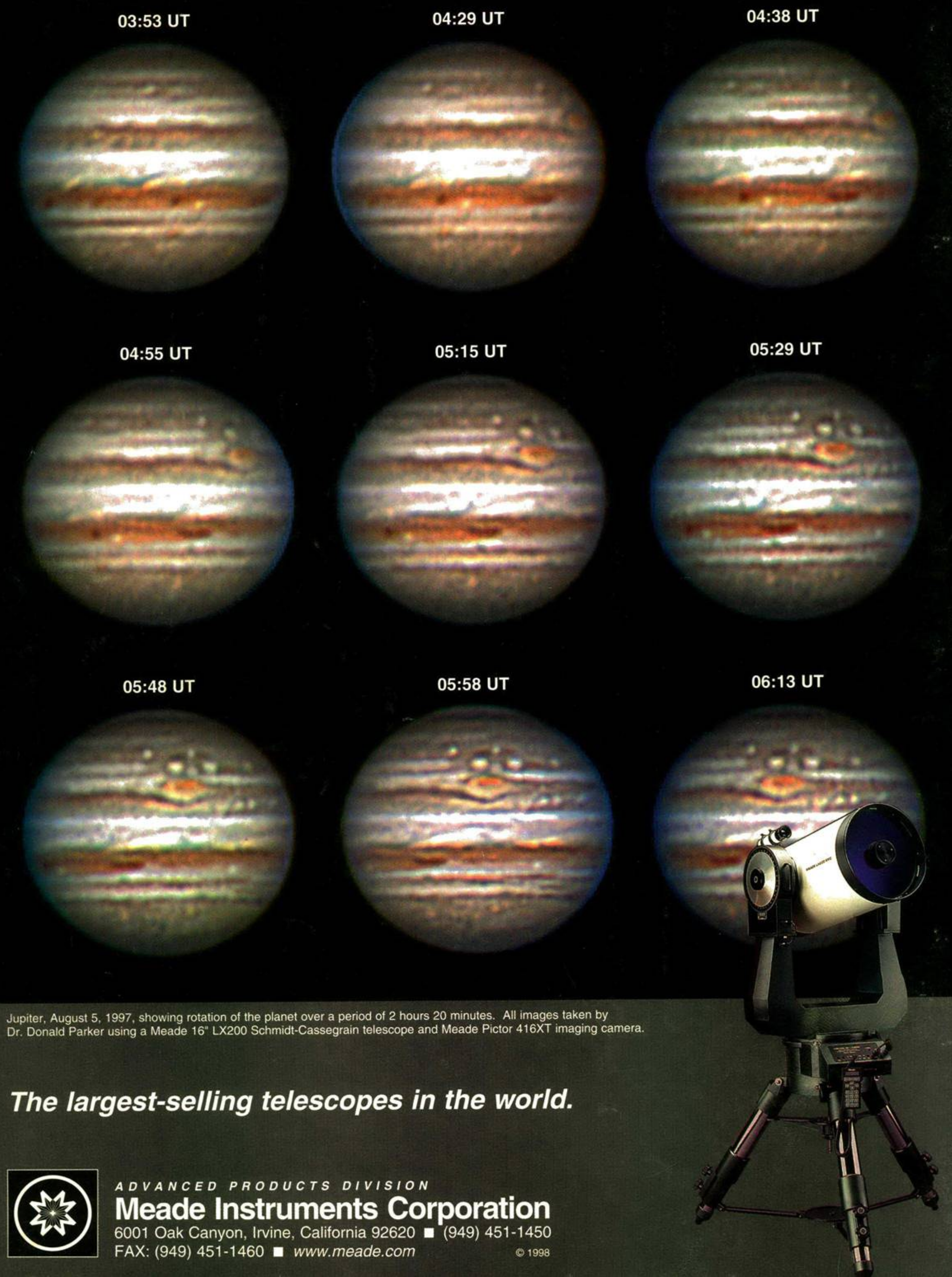
- ***Best craftsmanship*** *I've ever seen. — F.S. IN*
- *First day - birds, First night - **WOW**. Thank You!! — J.M. NC*
- *Returned a competitor's product within one day - sent your warranty card in one day. — R.D. IN*
- ***A proven winner** again and again! — M.Y. MI*
- *Bought two scopes, Ranger & competitor's 90mm Mak-Cass. Difference was laughable. Next day, **sent the Mak back**. — W.H. UT*
- *Wanted for rich-field viewing/astrophotography. Very impressed with sharpness at high power. **Rich-field view fantastic!** Impressed overall quality of craftsmanship. Thank you. — T.B. TX*
- *For stand-alone use/portability/use as guide-scope/finder for larger scope. It has lived up to all my expectations. It looks and feels as if it were **made by a jeweler** and the optics are first-rate. The wide-field views are astonishing with a UHC filter. — C.H. LA*
- *We'll take this one on trips when our Genesis-sdf is too bulky or otherwise inappropriate. Wonderful telescopes! We love both of them. **Great eyepieces too**. We have several. — K.W. GA*
- *I wanted a combination spotting and celestial telescope. **Surpasses my wildest expectations!**—M.C. OR*
- *Pronto is more than I expected.—R.G. CA*
- *Saw Jupiter & moons. **I was a kid again!** — S.H. PA*
- *It's Great fun! — W.D. OR*

Tele Vue owners are passionate about their scopes. Why? Because they enjoy travel-easy versatility, instant set-up, superb optical performance, quality, and lasting value — all in a 70mm E.D., f/6.8, diffraction-limited telescope. From our warranty card comments, you can see how Ranger & Pronto owners "get the picture." Call a Tele Vue dealer and "get it" too.

Ranger

Pronto

Tele Vue® Dept A, 100 Route 59, Suffern, NY 10901 (914) 357-9522 www.televue.com, literature $3


03:53 UT
04:29 UT
04:38 UT
04:55 UT
05:15 UT
05:29 UT
05:48 UT
05:58 UT
06:13 UT

Jupiter, August 5, 1997, showing rotation of the planet over a period of 2 hours 20 minutes. All images taken by Dr. Donald Parker using a Meade 16" LX200 Schmidt-Cassegrain telescope and Meade Pictor 416XT imaging camera.

The largest-selling telescopes in the world.

ADVANCED PRODUCTS DIVISION
Meade Instruments Corporation
6001 Oak Canyon, Irvine, California 92620 ■ (949) 451-1450
FAX: (949) 451-1460 ■ *www.meade.com*
© 1998